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Getting the Most Out of Your Machine Tool Dollar

"I think that anyone who has been connected with the output of precision products for a long time, and who has been responsible for equipment, will agree with me that the use of inefficient machines is waste—individual and economic. The problem becomes one of simple calculations that show when savings can be made and when they cannot. If the savings are there to be taken, it is management's responsiblity to take advantage of them."

By Robert F. Runge
Vice-President, SKF Industries, Inc.

A MACHINE in a plant of the SKF Industries is obsolete when it will no longer pay the dividends obtainable from some other machine. This statement is subject to qualification and can be applied only between limits, as will be seen, but it is the nearest approach to a concise statement that can be made.

Making ball bearings to sell at prices that are not prohibitive is a manufacturing, or "production" business. At the same time it is precision work and the equipment used must be given every consideration. A lack of business sense would be shown by adhering to worn-out or low-production machinery. It is self-evident that worn-out machines cannot be used on precision work. Low-production machines can, but if they are, a price is paid by the user, and that price is either lower profits or higher selling prices.

We do operate some inefficient machinery, that is, machines lower in output than other machines used on the same operations. One reason for their use is that the volume of output does not justify replacing the less efficient machines by the most efficient. Another reason is that in recent years great strides have been made in machine tools, providing for closer tolerances on the products made by them and increasing output. Competitors are quick to improve each on the other's machines, and developments have followed each other rapidly. Were we to replace every machine just as soon as something better is available, some of our equipment would not be in operation long enough to have given a reasonable return on the investment. Correct cost analysis shows whether or not a change should be made. Still another reason is that with a variety of sizes and quantities of bearings going through the shop, the most efficient machines for a given job may be employed on other work, with the consequence that less efficient machines must be used.

There is no guess work about it, because we know exactly the difference in cost of production between the inefficient and the efficient machines. This cost is shown on a report called "Weekly Summary of Operation and Inspection," compiled by the time-study department and sent to the production manager. It is a barometer that indicates the approach of the time for equipment buying.

Frequently we are asked what time we allow as the limit within which a new machine must pay for itself. The answer is always longer than the question. It simply is not feasible to set a time limit of one, two, or three years. We incline to the two-year period, but we have reservations. Usually two years are enough for a machine tool, when the savings consist of productive labor. But not always so. Sometimes we are able to see additional savings—in the elimination of re-operation work, reduction of re-operation inspection, disassembling work, reassembling work, even labor turn-over. Some machines are more easily operated than others and the workmen on that account are more likely to stay put. Dirty jobs and exhausting jobs should be eliminated wherever possible.

In one of our plants we recently installed sand-blasting equipment that greatly improved working conditions and added to the satisfaction of everyone in the department. That equipment will not pay for itself in

two years when only productive labor is considered, but we know it is a good investment, because it has raised the efficiency and the morale of the department.

An installation of electrical equipment has raised the power factor from 70 to 90, enabling us to take advantage of a lower rate on our meter readings. The equipment will not pay for itself under five years, but its life will be long, and after the five years are over the returns from the investment will be well worth while.

Conveyor equipment falls within the class that is relatively slow to pay for itself in terms of productive labor, but it has the economic advantages of eliminating manual work and strengthening the moral fabric of the plant.

Time-Study Department Makes Recommendations

Perhaps we do not follow the methods of the average plant in replacing and adding equipment, but to us our plan seems at once logical and simple. We believe that the time-study department has the closest touch with what our equipment is doing, and to that department are assigned the duties and responsibilities of keeping informed on developments and of initiating recommendations for purchase.

This method does not limit the work of discovering new equipment to the time-study department. Any individual in the organization may offer suggestions for equipment to be bought, and his suggestions will be considered. The distinction is between "may" and "duty." Whether suggestions originate in the time-study department or not, all of them clear through that department in the form of recommendations to purchase or not to purchase, with reasons why in either case. These recommendations are OKd or vetoed by a committee of three, who are the head of the time-study department, the production manager and the factory manager.

Replacing Equipment According to Formula

The recommendations are made according to a formula, which is none the less definite because for our own use we have not expressed it in algebraic terms. The information is a comparison between the existing cost and the proposed cost. It takes into account the expenditure for the new equipment, the interest on the investment over the period during which the equipment *must* pay for itself, depreciation for the same period, and the book value of the displaced equipment. It shows the savings in productive labor, the saving in overhead and finally the number of months in which the savings *will* pay for the equipment.

Savings in Productive Labor

To reach the figure just mentioned it is considered that the savings are made up of productive labor and that if the expense of productive labor is cut in half the percentage of overhead to productive labor is increased ten per cent.

The formula can be expressed algebraically as follows :

$$M = \frac{C_E + C_T + C_{IX} + C_{DX} + V_B}{(R_P - R_E)N_D D_M + S_{OHM}}$$

where

M = the number of months in which the equipment will pay for itself

C_E = the cost of the new equipment installed

C_T = the cost of tooling the new equipment

C_{IX} = the cost of interest for X years at 6 per cent, X equaling the number of years determined upon as the maximum time during which the equipment must pay for itself

C_{DX} = the cost of depreciation for X years at 10 per cent, X having the same value as in C_{DX}

V_B = the book value of the displaced equipment

R_P = the present rate (cost) per piece

R_E = the estimated rate (cost) on the proposed new equipment

N_D = the number of pieces to be produced per day by the proposed equipment

D_M = the number of working days per month

S_{OHM} = the savings in overhead per month

The formula appears formidable, and yet it is very simple when understood. It states that the number of months in which the equipment will pay for itself is equal to the total of expenditures for the new equipment divided by the total of savings per month. The derivation is not difficult. It is as follows:

The present rate per piece, R_P — the estimated rate on the proposed new equipment, R_E = the saving per piece:

$$R_P - R_E = \text{saving per piece.}$$

The saving per piece $\times$ the number of pieces produced per day, N_D = the savings per day:

$$(R_P - R_E)N_D = \text{savings per day.}$$

The savings per day $\times$ the number of working days per month, D_M = the savings in direct labor per month:

$$(R_P - R_E)N_D D_M = \text{savings in direct labor per month.}$$

The savings in direct labor per month + the savings in overhead per month, S_{OHM} = the total savings per month:

$$(R_P - R_E)N_D D_M + S_{OHM} = \text{total savings per month.}$$

The total expenditures = the cost of the new equipment installed, C_E + the cost of tooling, C_T + the cost of the interest at six per cent for the number of years determined upon as the time limit for self-payment, C_{IX} + the cost of depreciation at ten per cent per year for the same period, C_{DX} + the book value of the displaced equipment, V_B:

$$C_E + C_T + C_{IX} + C_{DX} + V_B = \text{total expenditures.}$$

Since the number of months in which the equipment will pay for itself, M = the total expenditures for the new equipment ÷ the total savings per month,

$$M = \frac{C_E + C_T + C_{IX} + C_{DX} + V_B}{(R_P - R_E)N_D D_M + S_{OHM}}.$$

Suppose that on a certain operation performed on three machines, the rate is $0.06 per piece and that we become convinced that two machines of another design can turn out the piece at a rate of $0.03 per piece. Assume that the number of pieces machined per day on the new equipment will be 1,000, that we work 20 days per month, that on this work we have a saving in overhead of $500 per month. For the figures of expenditure, take $10,000 as the cost of the new machines installed, 1,000 as the cost of tooling, and $1,000 apiece as the book value of the old machines. Consider that the machines must pay for themselves within two years, if they are to be bought. The interest at six per cent for two years on machines and tooling would be $1,320

and the depreciation for two years at ten per cent per year would be $2,200. The result of the application of these figures in the formula is

$$M = \frac{10{,}000 + 1{,}000 + 1{,}320 + 2{,}200 + 3{,}000}{(0.06 - 0.03)\ 1{,}000 \times 20 + 500}$$

$$= \frac{17{,}520}{1{,}100}$$

$$= 16 \text{ months.}$$

The expenditure would be justified, in fact would be imperative.

The example given is hypothetical but it is not extreme. The figures were chosen at random, yet with intent to give a statement of approximate truth. Our equipment is regularly checked along the steps outlined. The value of M is many times so great that no further consideration is necessary. But the calculations are gone through carefully, because if there is available a piece of equipment so superior to the machine we are using that it will give a relatively low value of M, we want to know it.

The value of a formula lies in its flexibility. If the rate per piece on the new equipment and the cost of the equipment, and so on, are known, as in the example used, the time M can be found. If the cost of new equipment and tooling are known and the time limit is set, the rate per piece at which it will be necessary to produce on the operation in question can be found. The solutions are obtained merely by the process of substitution. In the same way, the maximum allowable book value on old equipment or the obligatory savings in overhead can be calculated, since all of the factors except the one unknown that is being considered can be definitely determined or arbitrarily fixed.

Book Value and Overhead

There are two expressions in the formula that may cause some difficulty. At first thought it would seem that V_B, the book value of the displaced equipment, should not be considered an expenditure. As a rule it should, however, although sometimes it should not. It is certain that the difference between the book value and what the equipment sells for must be written off. There may be instances when the displaced equipment will be sold for more than the book value, and in those instances the term V_B will be replaced by figures representing a sum of money equal to the difference between the selling price and the book value. Its sign in the formula will be negative. Or, if the selling price is less than the book value, the term V_B will be replaced by figures representing in money the difference between the book value and the selling price, with a positive sign. These statements apply when the market for the old equipment has been found before the new is ordered. The book value has been chosen for use in the formula on the basis of calculating on the extreme condition of having to scrap the displaced equipment. This arrangement is a safe one to follow when the old equipment has not been sold. Usually the discarded machines have not been sold when the calculations are made and frequently they stand around for a long time.

The second expression subject to misinterpretation is S_{OHM}, representing savings in overhead per month. The accuracy of the determination of overhead depends upon the kind of cost system in use and the efficiency with which it is applied. It is our practice to know the overhead of individual machines as well as of departments and plants. Whether a formula is used or not, some consideration should be given to overhead costs in comparing old and new equipment, and in either case the result will be influenced by the limits of accuracy within which the overhead costs are determined.

I have said that we want to know about equipment more efficient than that in operation in our shops. There are several sources from which we draw information. Our time-study department is constantly on the alert for better equipment. So are the executive members of the organization. Our contacts are made through reading of new equipment in the technical press, by talking to the machinery builders' representatives, by advertisements, through visitors and by taking trips to other shops.

Guaranties Are Requested

All leads are followed up. If we think we see possibilities of the savings at which we aim, we ask the equipment maker for information, quotations and finally guaranties. All of our machines are bought on guaranteed production and are put in on approval. Parts are submitted to the builders so that they have every facility for knowing just what guaranties to make and they are encouraged to make demonstrations in our shops where the machines are installed.

There is a draw-back even to our careful method of buying. We cannot foresee the weak points that are likely to develop in the equipment bought. Many times we have had to make adjustments and corrections on machine tools to hold the accuracy of product that we must have. We have even gone so far as practically to rebuild machines. Apparently the trouble with them was that they were hurried too much in design and building on account of competitors' machines. Our experiences have led us to hope for an improvement in standards of workmanship on machine tools and I feel quite in order in expressing the belief that machines made to make other machines, or machine parts, should be started in life with great accuracy and with the best wearing qualities. Troubles arise from poor design and from wrong selection of materials. Perhaps more research work would do away with troubles from materials. Any maker of a product developed largely through research is likely to have that opinion, and it is offered here as a suggestion that is considered to have merit. Workmanship is another matter, and one that seems to be strictly up to management. It should be remembered that the tendency today is to work to closer tolerances on the products made by machine tools.

Recording and Budgeting Machine Repairs

We keep a record of the cost of repairs to individual machines which serves a very definite purpose in the formula given above and serves other purposes as well. We even have a budget for machine repairs. It is made up from past records, so that it is not merely an arbitrary figure. Any machine on which the repairs exceed the budget is due for some careful observation, and if the situation continues it is quite likely to be taken as a warning that a piece of new equipment is necessary.

We do not believe in accepting as final the statements of performance by the builders and by other users of machines that we are considering, although we do not doubt that they are made in good faith. Environment plays a big part in the success of a machine; so does the ability of management to eliminate prejudices. The

obvious procedure is to try the machines where they will be used.

Good machines have been discarded and sales have been lost through the narrow-mindedness of the men in charge of experimental work, and when that has happened it has been a reflection back to the type of management under which the machines were being tried. Other machines have failed because the results gotten from them have not been thoroughly analyzed by the user. Such failures are not due to faults of the machine tool builders, but they are the ones penalized. These things tend to make the builder discount the comments of the users of his machines, and that is to be regretted, because it will be to his own good to take seriously those comments that point out opportunities for improvements.

There is one phase of the replacement story yet uncovered; it is the disposition of displaced equipment. With us there are three things to do—find customers for the machines, sell them to dealers in used machinery, and scrap them. We do all three, depending upon the kind of machine for disposition and the markets available. The disposition of old equipment affects the value of the investment in new, as pointed out in commenting upon book value as an expenditure. Experience has made it possible for us to know just about what can be done and we act accordingly.

I think that anyone who has been connected with the output of precision products for a long time, and who has been responsible for equipment, will agree with me that the use of inefficient machines is waste—individual and economic. The problem becomes one of simple calculations that show when savings can be made and when they cannot. If the savings are there to be taken, it is management's repsonsibility to take advantage of them.

[The preceding article is the third under the title, "Getting the Most Out of Your Machine Tool Dollar." The first article, by J. A. Smith, General Superintendent of the General Electric Co., Schenectady, N. Y., was published in page 409. The second, by C. A. Shaffer, General Supervisor of Machinery and Tools of the Illinois Central Railroad, was published on page 521. Other articles on the same subject will be published in forthcoming issues.]

Master Tools or Merchandise?

By Lee Walters

"I WONDER what would happen if....." is a question all of us have put to ourselves many a time, and then we wondered why we were asking such questions, at all, for no man can say with certainty what would have happened if something had happened that hasn't happened. And yet such questions are not always so futile as they look. They often give us an idea of the real value of things. We get a vivid picture of the value of water by imagining a world without it. We find sometimes that in a pinch we could get along without this thing but not without that; that such a thing could be easily replaced or something substituted for it while another thing may be absolutely essential or may be so hard to replace that its temporary absence would cause real hardship.

Take, for instance, the case of machine tools. What would happen if all machine tools were suddenly wiped out? And let us ask the same question about some other classes of machinery. It may give us a clearer idea of their relative importance.

Suppose, for instance, that all textile machinery were suddenly wiped out; what would we do? Why we would get busy and build new ones. The knowledge of what is wanted and how to accomplish it is still there; we still have the materials and tools to make them and if everyone got busy it would be a few years, at the worst, before things would be going again as before. In the meantime we would get along with the clothes and things we have and build up a savings account. And so with other classes of machinery. The absence of some would hardly be felt, that of others would be a real hardship, calamity even, but a few years would put the world back where it was before the cyclone struck it.

But now imagine that all machine tools were suddenly removed. Though we would still have the skill to design and make them, though the materials would still be at hand, yet we would not be able to produce machine tools. We would hold the same position as we hold in relation to the moon. We know where it is but we cannot get there.

Machine tools are not merely the result of knowledge and skill. They are essentially the result of evolution, and are tied up inseparably with the past. We could not build a machine tool if we did not have one, nor can we have one without building one. We would have to begin again at the beginning and go once more through the main phases of development of the machine tool industry. We could not make anything round or flat, except by the most primitive methods. Just imagine the fun of making such a simple thing as a gear wheel or the index plate of a dividing head, or even a screw.

Machine tools are not merely the "Master Tools of Industry," they are the last rung in our ladder of mechanical progress. Whereas the machine tools can produce any other kind of machinery, no other kind of machinery can produce a machine tool. They are the only machines which are sufficient unto themselves and the direct outcome of human progress. Remove them and the world will have to go through many years of darkness and hardship before even a semblance of the present state of development can be reached.

Why then are machine tools the stepchildren of the investor, and why is the machine tool man without honor to his country? Is it because he is not aware of his own importance, or is it perhaps because in his struggle for existence he has reduced the "Master Tools of Industry" to mere merchandise?

Suggestion Boxes and the Morale of Workmen

Speaking recently of the relations between management and employee and the value of suggestions to both, Gerard Swope, president of the General Electric Co., Schenectady, N. Y., said:

"The effect upon the organization of these suggestions by workmen is of even greater importance than the reduction in cost and the monetary rewards to the men, because of the stimulation to the men themselves and to the *esprit de corps* of the organization as a whole, because of the recognition that the working-man is a live, integral part of the business and may contribute to a greater extent than he has heretofore in its upbuilding. This gives the working-man a greater interest and keener sense of enjoyment from his work, as he feels that he has made a constructive contribution. The recognition that has come to him is not only appreciated, but causes him to be respected by his associates."

Automotive Production

Machining Poppet Valves for Gasoline Engines

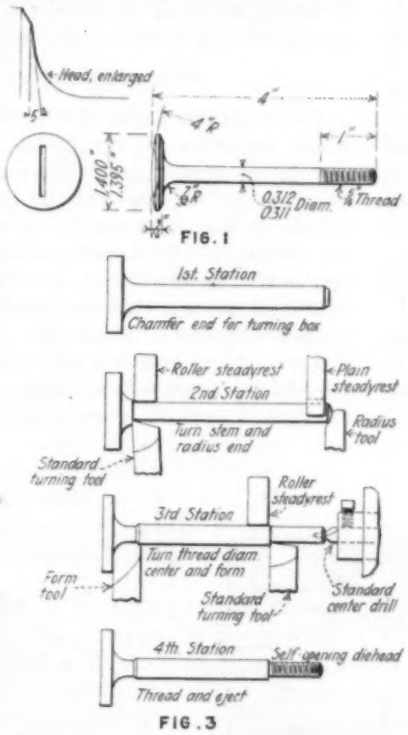
By F. Osgood

Consideration of product to be manufactured—Layout of operations—Method of roughing on automatic—Tools and fixtures used for turning, grinding and milling

THE machining of poppet valves for gasoline engines is not an involved matter and it would not appear, at first glance, that a varied choice methods is possible. This is far from being the case, even when considering any one type or size of valve and no doubt many readers will recollect the various methods used in different shops in the past, as does the writer. The object of this article is to outline a production method on one particular design of valve, a type which is more commonly used in these days of overhead valves than ten years ago, when the "side-by-side" style was practically the only type used.

The valve to be considered, Fig. 1, differs from the average design, in that the end of the stem is threaded instead of having the usual cotter slot or recess for the spring shoe retainer. The thread is for adjusting nuts and materially affects the production method. The layout of operations, Fig. 2, gives the machining process together with the machines used.

The first operation is performed on a hand-screw machine using a spring collet for gripping the work. In order to assist the following operation, very little stock is taken off the top face of the head. The work is located by being pushed back into the chuck to a stop in the turret, rather than to locate from the chuck itself which is a usual procedure. By this method, the top face of the head, which is to be machined, is definitely located in relation to the facing tool, so that a minimum cut of approximately 0.01 in. is taken. The material of the work being a nickel steel forging, has a somewhat tough scale which causes excessive wear on the cutting tools, however the maintenance of the facing tool is not heavy, while the economy effected in the succeeding operation is considerable. The outside diameter of the head is also machined, providing a chucking diameter for the next operation, while the top face provides for the end location, this being essential as the amount gripped by the chuck, is small.



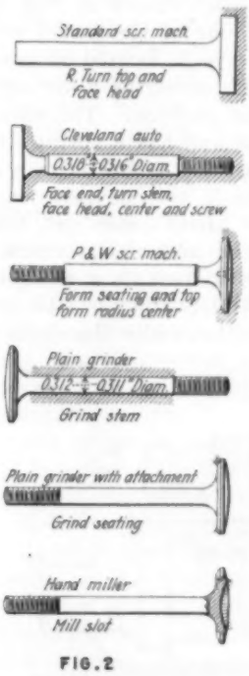


Fig. 1—Details of valve to be machined. Fig. 2—Layout of operations. Fig. 3—Details of the second operation as performed on an automatic

Details of the second operation as performed on an automatic are shown in Fig. 3. A standard pointing tool chamfers the end of the stem at the first station. At the second station, using a roller steady, the stem

AUTOMOTIVE PRODUCTION

is trued to limits of ±0.002 in., these limits being held for the following chuckings. A plain steadyrest supports the end of the stem opposite the radius-form tool, thus guarding against any detrimental effects being produced on the truing tool. The threaded end is turned and center-drilled at the third station and while the roller is engaged on the stem as shown, the underside of the head is finished formed. As a maximum amount of material has been left on the valve head, the form tool gets well under the scale, requiring only one grinding per day. A contributary

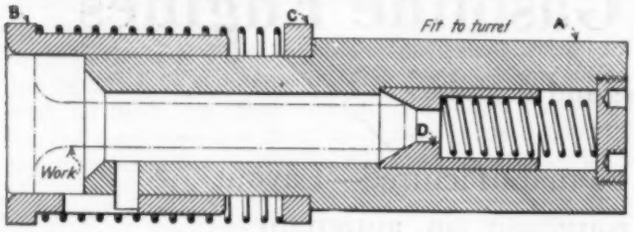


Fig. 4—Chucking device used on second operation

factor to the efficiency of this tool is the special forming of the back face of the head which is on an angle of 5 deg. instead of flat. This angle gives the necessary relief to prevent the tool from rubbing, reducing its wear. At the last station the end of the stem is threaded with a standard form of diehead and calls for no further comment.

In order to chuck the valve so that the shank is reasonably true and the face of the head is up to the face on the chuck, the device shown in Fig. 4 is used. This device is located in one of the turret holes. The shank *A* has a sliding sleeve *B*, located on one end, and the collar *C* at the center, acting as a spring stop and keeping *B* at its outmost position. The plunger *D* is a sliding fit in the shank and has a spring at the rear end to keep it in contact with the valve stem. The operator places the valve in this device occupying the position shown. As the turret feeds out, the head of the valve, guided by the sleeve *B*, enters into the collet; the sleeve *B* sliding back as it strikes the face of the collet. The conical portion of the plunger *D*, keeps the valve stem central while the collet is closed. Details of the collet and the device for ejecting the work are shown in Fig. 5. The collet is of simple design, while the ejecting device merely consists of a plug fixed to the feed tube of the machine. The action of the ejector is arranged to work immediately after the self-opening diehead is at the back-most position. By means of a special cam plate fixed on the feed cam, the feed tube is withdrawn as soon as the piece is ejected. The machining time for this operation is 2½ min. The operator can look after two additional machines, providing they are producing simple work, allowing a good portion of his time on this operation.

The third operation is performed on a turret lathe, using a special chuck that has no lateral motion when operated. A section of this chuck, is shown in Fig. 6, together with the cross-slide tools. The collet *A* is special; the rest being of standard equipment. The closing sleeve *B*, is actuated by the usual push-bar attachment. The tool *C*, is first brought into operation, forming the valve seat, finishing the outside diameter and chamfering the front face, to ease the cut of the radius form-tool *D*. The form-tool *D* is fixed on the back tool post in an inverted position to eliminate chatter. A center hole is then drilled, completing the operation.

The stem of the valve is ground complete in a plain grinding machine at the fourth operation. The work is located on centers and is driven by the head end.

The valve seat is finish-ground at the fifth operation. A plain grinding machine is used, equipped with a spring-collet attachment for holding the work.

Milling Slot in Head End

The milling of the slot is the sixth and final operation, in order to retain the central location of the slot in the valve head. The hand grinding of the valve at assembly, requires the slot central. The fixture used, shown in Fig. 7 is simple in construction and efficient in operation. The spring collet *A* grips the shank of the work at the head end; a rough location being provided at the threaded end of the work to ensure proper alignment when the collet is tightened. The collet is tightened by the hand lever *B* fitted to the threaded portion of the collet. A key *C* holds the collet

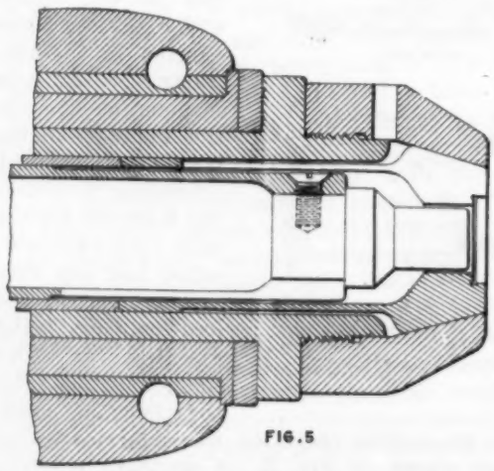


FIG. 5

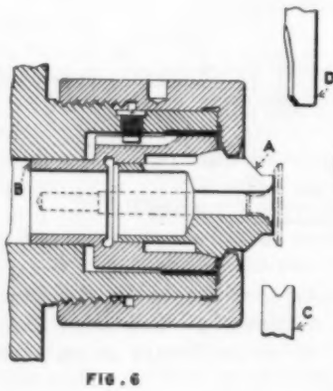


FIG. 6

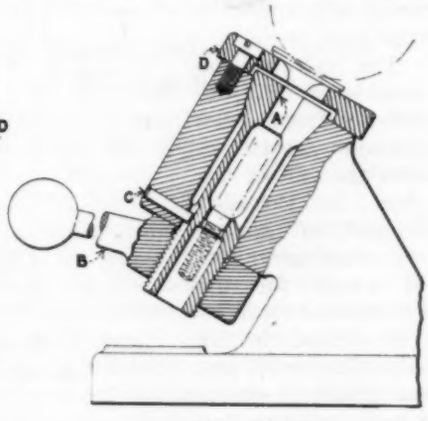


FIG. 7

Fig. 5—Collet provided with ejector. Fig. 6—Sectional view of chuck used in forming head end. Fig. 7—Fixture used for milling slot

in position and the plate *D* locates the work vertically and protects the collet from cutter chips.

The work is held in the fixture at an angle of 60 deg., avoiding the additional movement of the machine table when loading, which would be required if its position was horizontal. This feature made possible an output of 150 pieces per hour.

The layout outlined has given efficient results for the amount of production required by British automobile plants. The machine tools used are of the plain type and the special tools are reduced to a minimum, being simple in design to render easy replacements when necessary.

While the type of valve as indicated in Fig. 1 has been considered, the general procedure can be profitably applied to other types of valves. The writer's experience confirms this, even in the use of an automatic machine for the second operation.

Abstracts

from other publications

Unusual Manufacturing Difficulties

C. Roy Keys, vice-president, the Curtiss Aeroplane & Motor Co., Inc., contributes a brief but interesting article on the special difficulties entering into the manufacturing of airplane engines.

Breakage of parts in these engines is not only a bother but a serious matter as such breakages while the plane is in use may cost a man's life or the loss of the airplane. Every broken part that comes to the attention of the Curtiss company is, therefore, put under close scrutiny with a view of finding out why it broke and how any similar breakage can be prevented in the future. All of these tests of new and old parts drew one lesson, namely that the most general cause of breakage was sharp angles. A part moving in operation becomes heated and the expansion and contraction, as well as the mechanical strain, has a concentrated effect on the sharp corners. Consequently exterior corners are rounded off and the interior angles are filled with a fillet of considerable radius. There is not a single square-faced milling cutter used in the shop, even the so-called square-faced milling cutter has a radius of $\frac{1}{64}$ in. at the corner, but usually fillets are designed of greater radii.

In drilling the camshaft it was found that drilling at each end caused a tiny ring or edge at the meeting place in the center. This was bound to cause ultimate breakage so that now the camshafts are drilled through from one end. Each part is studied as to whether it may be made for longer life and a diligent search for new alloys and proper application is made. They have produced a motor weighing 680 lb. which gives 600 hp., or a little less than 1 hp. for every pound of motor weight. Forty different metals are used in the same motor.

Most shops are content with testing one screw out of every package or hundred, or dozen, but the Curtiss company tests every screw individually by a projection apparatus that throws an enlarged image of the screw upon a printed screen. These tests insure against the rapid vibration in an airplane of loosening the parts. The precautions seem costly, but they are a great economy in that they fulfill their object. Sand blasting has been replaced by a tumbling operation with steel shot. This obviates the possibility of small pieces of sand getting into the wearing parts and causing lessened life.

If these precautions are applied, the likelihood of breakage of mechanical parts will diminish to the vanishing point.—*Management and Administration*, April, p. 373.

Cadillac Foundries

The three new foundries of the Cadillac Motor Car Co. are described by Fred L. Prentiss. These represent the latest ideas in this work.

One of the most prominent features is that the three foundries for iron, aluminum and brass, are all arranged for continuous operation and are combined in one plant with one sand-handling and storage department, a single core-making, baking and finishing department for the three units, effecting obvious economies. Other outstanding features include labor-saving equipment for handling material, convenient arrangement for the different units, ventilation and heating.

The use of manual labor has been reduced to a minimum. A conspicuous illustration being the fact that core-sand is not handled by hand from delivery to plant until it reaches the coremaker's bench. There are two independent systems for preparation and distribution of the two grades of molding-sand used and the overhead monorail system is used for distributing cores and sand to parts of the foundries.—*The Iron Age*, April 2, p. 1035.

Maintenance Equipment

B. M. Ikert reports the result of a survey of automotive shops in a town of 10,000. He found five were equipped with lathes, six with drill presses, four with electric drill presses ready to be used or operated as drill presses, ten with power grinders, five with arbor presses, seven with cylinder tools, and seven of the shops had welding outfits.

In this town, however, there is a community machine shop and it is interesting to note the equipment in this shop, which was as follows: one 28-in. by 14-ft. Barnes lathe, one 18-in. by 10-ft. South Bend lathe, one 14-in. by 6-ft. Carrol-Jamison lathe, one 21-in. by 10-ft. Le Blond lathe, one Le Blond universal milling machine, one No. 55 Heald internal grinder, one 6-in. by 32-in. Norton universal grinder, one Marvel reboring machine, one American planer, one arbor press, one large drill press, one sensitive drill press, and one welding outfit. In addition, the shop had a full line of reamers of every type, etc.

This town was selected by Mr. Ikert as a typical small town, it being the largest town for several hundred miles around. One of the notable showings of the survey was the lack of main bearing and connecting-rod bearing tools.—*Motor Age*, April 9, p. 9.

Book Reviews

Report of the National Screw Thread Commission. One hundred seventy-two pages, 7x10 in. Miscellaneous Publication, Bureau of Standards No. 61, Supt. of Printing, Washington, D. C. Price 35 cents.

This is the revised, 1924, edition of the report of the National Screw Thread Commission and should be in the hands of every manufacturer using screw threads in his product. It represents an incalculable amount of work by dozens of the best engineers in the country and contains the most complete information that has ever been compiled on screw threads.

The tables are most complete and the illustrations show exactly what is meant by all the definitions and terms used. The report includes the methods of gaging as well as the sizes of various threads. It shows accepted tolerances on both the threaded products and the gages with which they are measured. Pipe threads of various kinds are shown, as well as the new hose coupling and other standards. Specifications for threading tools are also included. In fact, the report seems to cover about all the points that could come up in connection with threaded work.

Proceedings of the Twenty-Seventh Annual Meeting. By the American Society for Testing Materials; 1315 Spruce St., Philadelphia, Pa. Volume 24, in two parts, 1172 and 1133 pages, 6x9 inches. Published by the Society. Price of each part $6 in paper, $6.50 in cloth and $8 in half-leather binding.

This volume, in two parts, represents the proceedings of the annual meeting of the American Society for Testing Materials held at Atlantic City, on June 1924. The first part contains the reports of 35 committees, including discussions and reports, and 87 tentative standards which have been revised or published for the first time. The annual address of the president and report of the executive committee are given. Many charts, illustrations, tables and testing data of various materials are included.

The second part contains 47 technical papers with discussions, including valuable information on results of investigations in the field of engineering materials. A symposium on corrosion-resistant, heat-resistant and electrical-resistant alloys is given, including new and valuable data for users of these alloys.

Recent Progress in Engineering Production. By C. M. Linley. Three hundred forty pages, 7x9¾-in., board covers. Illustrated. Published by D. Van Nostrand Co., New York City. Price $10.

The purpose of this book is to keep engineers in touch with the latest developments and improvements in manufacturing processes and the tools used in production.

Since the author is not connected with any builders of machine tools, he has been able to deal with his subject in an entirely unbiased manner, and has therefore felt at liberty to recommend the use of certain machines for specific purposes. He has also furnished sufficient information to enable the reader to get in touch with the makers of many of the machines described.

In addition to methods known purely as machine work, other processes and equipment used in production, such as autogenous cutting and welding, hardening, use of pyrometers, centrifugal casting, electric furnaces, balancing, testing and gaging instruments, lighting and heating have been admirably dealt with.

The book is a veritable encyclopedia of both American and English machines and processes, and the engineer who reads and studies it will be well repaid.

Publicity—Some of the Things It Is and Is Not. By Ivy L. Lee. Sixty-four pages, 5x6 in. Board covers. Published by the Industries Publishing Co., 80 Lafayette St., New York City. Price $1.

Here is a little book that can be read in about an hour. It is particularly worth while for publicity and advertising men. Its virtues include clear definitions of such terms as "publicity" and "propaganda" and some very fair statements about advertising.

Mr. Lee's book consists of two addresses and some discussion. One of the addresses was delivered twice—before an association of teachers of journalism and before an advertising club. The other was delivered before members of the American Electric Railway Association in convention. The discussion pertains to the first address.

Hendricks' Commercial Register of the United States. Two thousand five hundred twenty-two pages, 8x11, board covers. Published by S. E. Hendricks Co., Incorporated, New York City. Price $12.

The thirty-third edition of our old friend Hendricks is just off the press. While it is somewhat late it is none the less welcome, since it has kept pace with the many changes in firm names and addresses.

For all who have anything to do with buying or selling the book is invaluable and a purchasing agent who does not have a copy of *Hendricks* on his desk is sadly behind the times.

In the front of the book 311 pages are devoted to a list of manufacturers and distributors, and 165 pages to an index of various articles.

In the back, trade names of manufactured goods occupy 212 pages.

The Bureau of Standards of the Department of Commerce has issued a table for converting the diameter of Brinell impressions to Brinell hardness numbers.

The table was prepared by the engineering mechanics section of the bureau. It is printed on tagboard and is known as Miscellaneous Publication of the Bureau of Standards No. 62. The size is 11x14 in. and the price is 5c. per copy.

Bulletin on Standardization

A recent Bulletin, No. 9, issued by the A.E.S.C. contains much of interest to all who appreciate the benefits to be gained by the standardization of machine sizes and elements. It calls attention to several new British standards on keys, bolts, nuts, studs, screws, pins, washers, etc., and also a standard set of fits for machine work.

The British Committee unanimously recommends the use of unilateral tolerances for cylindrical mating surfaces where it does not conflict with existing practice. Austrian, Swedish and Czechoslovakian standards of various kinds are also given. This bulletin is sent to its sustaining-membership by the American Engineering Standards Committee.

The Manufacture of Raybestos Brake and Clutch Linings

By Ellsworth Sheldon
New England Editor, *American Machinist*

Asbestos is a mineral textile — It is spun and woven like cotton or silk — Friction linings are made by both the weaving and molding processes

WHILE waiting in a local garage a few days since for a minor adjustment to my car I engaged in desultory conversation with a fellow motorist who stood leaning against a bench and idly picking apart the strands of a piece of Raybestos brake lining with his pen-knife.

"What do you suppose this stuff is made of?" asked my friend, without regard for the rules of grammar.

"Asbestos," I replied, promptly.

"How can it be made of asbestos, when asbestos is nothing but a rock?" was his further inquiry. "I'll tell you," he continued, as his mind really got to work upon the subject; "they pulverize the rock, mix it with some kind of liquid and impregnate a cotton belt with it under heat and pressure."

"I don't know how it is made," I admitted, "but I think you're wrong. Anyway, I will find out and let you know." And that is just what I did.

Rather to my surprise when I broached the proposition to the management of The Raybestos Co. it was received with unqualified approval. The plants at Bridgeport and Stratford, Conn., were thrown open to my inspection from laboratory to shipping room and every facility was extended to me for acquiring the desired knowledge of the product and manufacturing processes. To F. C. Stanley, Ph. D., Chief Engineer of the Company, I am principally indebted for the technical details.

My garage acquaintance was right in one respect. Asbestos, as everybody (except myself) knew long ago, *is* a rock; but it is a very peculiar kind of rock. The geologists and scientists call it "serpentine," and while they are agreed as to its nature and characteristics, there is much difference of opinion among them as to the manner in which the long glassy-appearing fibers came to be deposited in strata between opposed masses of the mother-rock in which it is found. However, as the deposits occurred some millions of years ago, and as nature has left us sufficient material to supply our needs until the next solar eclipse in New England at least, we need not intrude in the doctor's quarrel.

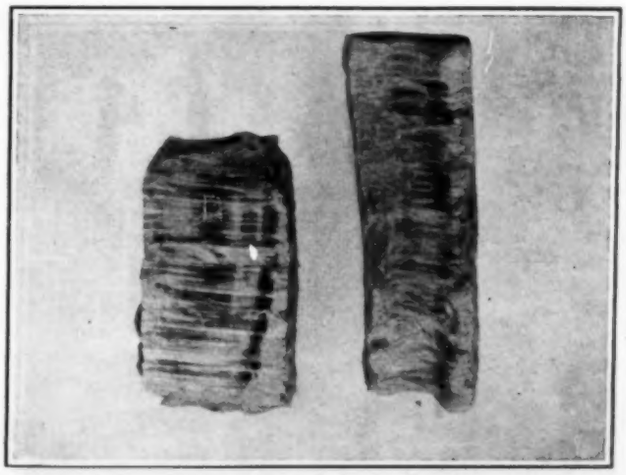


Fig. 1—Crude asbestos

Fig. 2—The crusher

There are several varieties of natural asbestos, but we need concern ourselves with but one kind—chrysotile—that is of industrial consequence. Chrysotile is rather widely distributed over the surface of the earth, but the principal commercial deposits are in Canada, where the rock is blasted out of hillside and tunnel and transported on mine cars to the crushing plants in which it is handled very much in the same manner as traprock that is to be used as road building material.

The illustration Fig. 1 shows a couple of lumps of the "crude," as it is called when received at the Stratford plant. The fibrous structure can easily be discerned in the picture. The fibers are disposed endwise between two thin films of rock to which the ends adhere strongly, and a "vein" of this kind may extend for

yards—or miles—into the ledge. Before it is disturbed the massed fiber has a glassy appearance, but the individual fibers can be picked out easily with the fingernail, and when twirled between thumb and fingers they fluff up and assume the appearance of coarse wool. The fibers may be of any length up to four or five inches, but the major portion of workable material ranges from $\frac{3}{8}$ to $1\frac{1}{4}$ in. in length as a general rule.

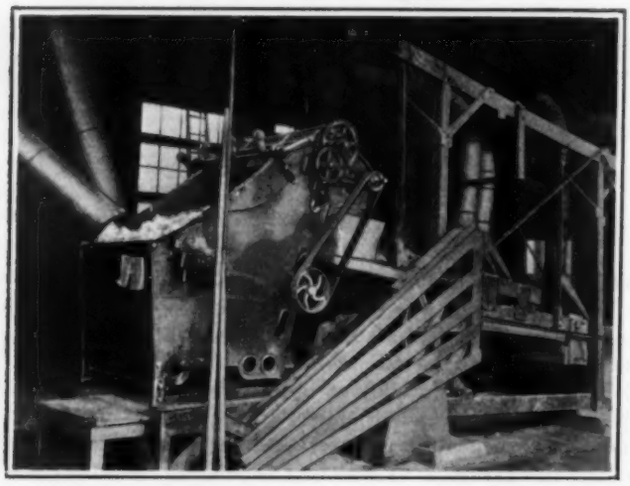


Fig. 3—The sorting machine

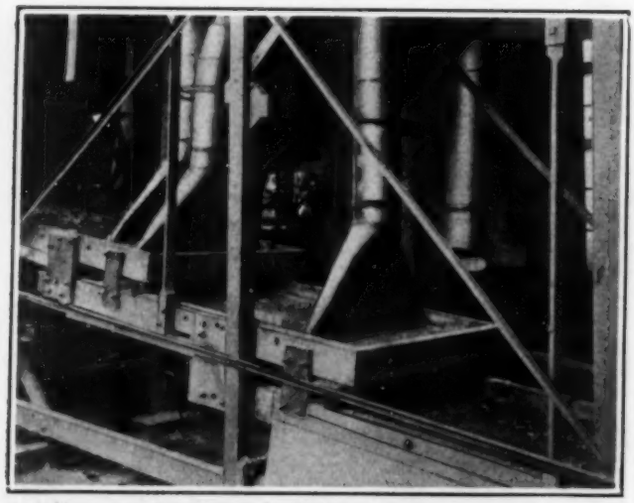


Fig. 4—Screens of the sorting machine

Fig. 5—Grades of asbestos fiber

The first operation to which the crude material is subjected is crushing, for which purpose a quantity is dumped into the pan of the crusher, Fig. 2, and the heavy wheels of cast iron allowed to roll slowly over the mass until the fibers are fluffed up into "wool" and the remaining rock is reduced to powder.

From the crusher the mass of material goes to a centrifugal separator which disposes of the rock dust and delivers the fiber to storage bins on an upper floor, from which it is drawn through conduits of sheet metal to the hopper of the sorting machine, Figs. 3 and 4, and separated by the machine into several grades according to the length of the individual fibers.

An endless conveyor in the hopper of the machine at Fig. 3 passes the fiber through slowly revolving rolls that straighten it out and drop it on to the first of the inclined vibrating screens to be seen in Fig. 4. As it passes over these screens the shorter fibers drop through the mesh to the next succeeding screen while the longer ones pass to the ends of the respective screens where they are picked up by suction and deposited in corresponding receptacles beside the machine. Fig. 5 shows these receptacles, which are wooden boxes fitted with casters to facilitate transportation.

From this point forward the fibers are handled separately, and follow three entirely distinct paths ac-

Fig. 6—A carding machine

Fig. 8—Cop winding machine

cording to their length. Only the longest fibers go into webbing, while the shorter ones are used to make molded linings and sheet packing. The former process is quite analogous to the making of cotton fabrics and, indeed, uses the same machinery. Shorter fibers go to machines that are identical with those used in making wood pulp for paper, while fibers of moderate length, ¼ to ½ in., are handled in the mixers and rolls of a rubber mill and are made into sheet packing and gaskets for packing the joints of steam and hydraulic machinery. We will for the present leave the two latter applications and follow the long fibers through the processes by which they are converted into the familiar brake lining as used on automobiles.

It is at this point that my garage freind's idea of the manufacture of asbestos fabric began to go wrong. There is no "cotton belting" anywhere in the process; nor is any needed. To be sure, the asbestos fibers are "rock"—chemically speaking, hydrous magnesium silicate—but they possess nearly all of the characteristics of cotton fiber and in addition have a few of their own; they are absolutely incombustible and they are impervious to the action of most acids.

They are lacking in one distinctive feature. Cotton fiber (and in greater degree wool and fur) are covered with minute "hooks," or barbs, that give to them the property of felting, or clinging to each other when twisted together. Asbestos fiber is smooth, or "slick," and while it can be spun into yarn quite readily, the yarn will not have the tensile strength of cotton. For this reason a very small amount of cotton fiber, never more than ten and seldom more than five percent, is thoroughly mixed with the asbestos before it proceeds to the later processes.

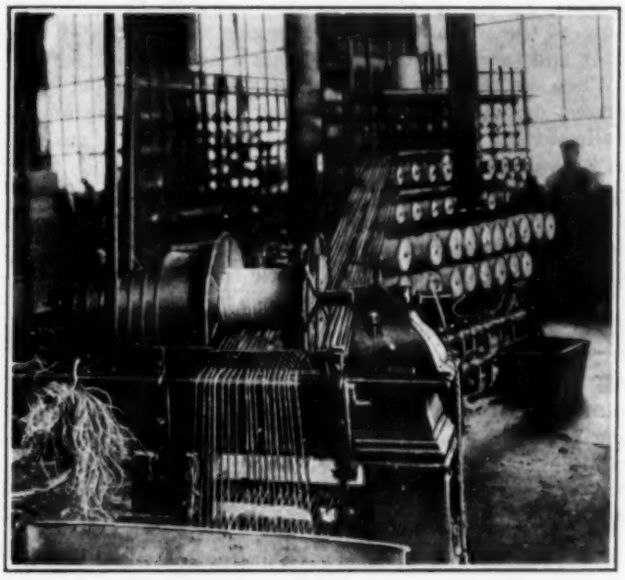


Fig. 7—Winding the warps

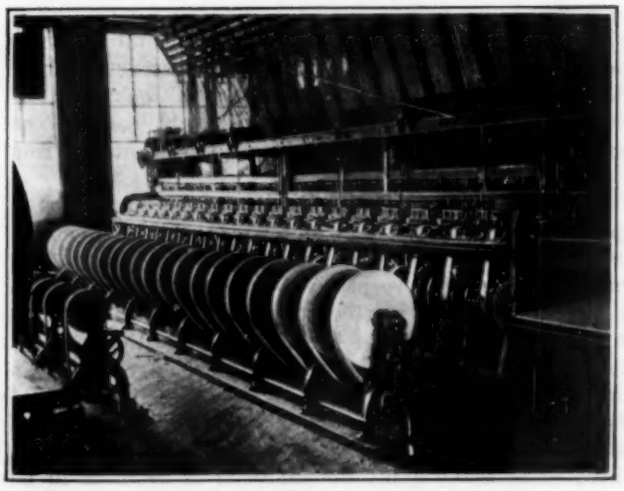


Fig. 9—One of the looms

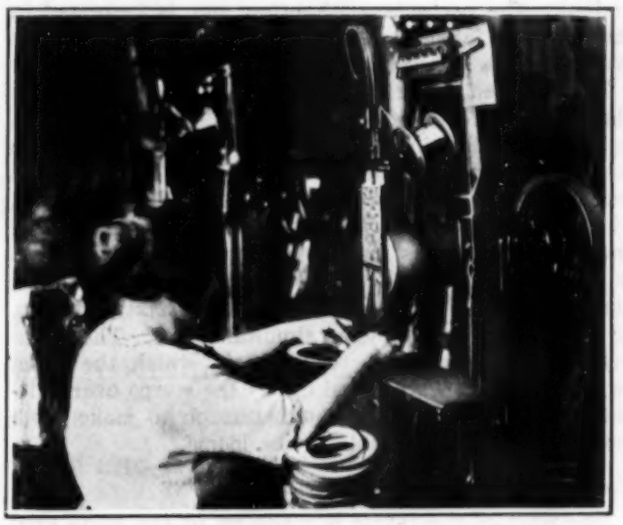


Fig. 10—Cutting off the rings of clutch facing

Fig. 11—Stitching the ends of the rings

A carding machine through which the unmixed fibers of medium length pass on their way to become molded brake lining or sheet packing appears in Fig. 6. In the spinning mill the cotton fibers are added at the carding machines and the mixture goes thence to the roving machines and spinning frames where it is converted into yarn for the looms.

In the spinning mill the yarns are twisted together with fine wires into warps. The wire is of soft brass, 0.008 in. in diameter, and is combined with the asbestos strands in different proportions: 2 and 2 or 3 and 2, meaning that there are two strands of asbestos and two of wire or three of asbestos and two of wire respectively. Asbestos fabrics are made without any wire whatever for some purposes, but owing to the lack of strength as above noted the application is

limited. The percentage of cotton, too, is increased in the unwired fabrics. None of the latter is used for brake linings.

The twisted warp is delivered to the Bridgeport plant in the form of cylindrical balls, or "packages" as they are called in the shop, several of which may be seen on the frame in the back ground of Fig. 7, where the warps are being wound on a "beam" for the looms. The fabric is made in all thicknesses from $\frac{1}{8}$ to $1\frac{1}{4}$ in., and the difference is mainly in the number of strands in the warp and weft. The beam is a large spool with flanges of sheet metal, and as many as sixty strands, or "ends," may be wound on simultaneously. The winding machine is a converted lathe in which the beam swings between centers and draws the warps over suitable rollers that impose enough tension to make them more pliable and tractable in the looms.

How the Weaving Is Done

The weft of the fabric is made up of the same kind of yarns as the warp. and is distributed in the looms by the shuttles. For this purpose it is wound into long sylindrical balls called "cops." The cops are entirely self-supporting, there being no spool or core in them, and they are of a shape and size to fit in the shuttles of the looms. Fig. 8 shows one of the many cop winders at the Bridgeport plant.

There are a hundred or more of the looms in the plant, ranging all the way from a narrow machine that weaves a single web about a foot wide up to the twenty section loom shown in Fig. 9, which will weave twenty webs, each 3 in. wide, simultaneously. The looms are exactly the same in principle as those used to weave cotton fabrics, but are special in construction in order to handle the heavy work. The warps may be seen in the picture, coming down over the wooden rollers that lead them from the beams in the rear and deliver them to the "harnesses" that separate the warps at each movement so that the shuttle may draw the single yarn of the weft between them.

If the fabric to be woven is of only one ply there will be need for but two harnesses (that is, two for each section) one moving down as the other moves up; but on some of the looms there are as many as sixteen harnesses, each directing the movements of the full number of warps for each ply. Consequently, when one harness moves down it stays there until the loom has passed through the remaining fifteen cycles, moving a different harness each time, and in the meantime the thread of the weft (called the "filling") has been drawn back and forth sixteen times. That is what builds up the thick fabric to a point somewhat more that it will finally finish.

Any loom can be adjusted to use any number of harnesses up to its limit and is therefore capable of weaving any number of plies. The looms run continuously unless stopped by the operator to knot a broken warp or supply a new cop to an exhausted shuttle. The woven webs wind automatically upon the coils to be seen in front of the machine.

From the weaving room the coils of webbing pass to the vats and ovens where they are impregnated with a compound that serves the double duty of binding the fabric together and of making it impervious to moisture as well as resistant to wear. The saturation and curing is carried on in a continuous process, made uniform by accurate temperature control so that the fabric is impregnated completely and so thoroughly cured that its frictional efficiency is constant at all braking temperatures.

Several coils of webbing are hung on frames before each oven and the ends of the fabric passed into a series of power-driven rolls that lead it through the hot solution in the tank, through a pair of squeezing rolls to press out the excess solution, and over the train of rollers in the oven. The rate of travel is governed by means of friction cones in the driving mechanism, and is adjusted to give the saturated webbing time to bake, or "cure," in its passage through the oven. The rate of travel varies with the thickness of the webbing.

As it issues from the oven the hot webbing is passed between a pair of squeezing rolls so adjusted as to apply a heavy pressure, thus compressing the material, which is slightly plastic when hot, into a compact ribbon of almost metallic hardness. It is then wound into coils and, if intended for brake lining, requires no further mechanical treatment.

When the material is to be made into clutch facings it requires a somewhat different method of handling from the time it enters the treating room. The webbing is first wound edgewise on hollow arbors of cast iron until a helix of two or three feet in length is built up. The winding machines are converted engine lathes with suitable guides attached to the carriage to hold the plane of the webbing at right angles to the axis of the arbor and subject it to the necessary tension as it winds.

When an arbor is full the helix is confined between flanges, drawn together with long bolts, and the arbor is slipped out of the coil. In this condition it is soaked in a tank of the impregnating compound and then transferred to the oven for baking. When thoroughly cured the flanges are removed and the material goes to the foot-press shown in Fig. 10, where the webbing is cut off in lengths equal to a single turn of the helix.

The ends of each severed ring are then stitched together with soft brass wire, the machine used for the purpose being shown in Fig. 11. This operation is a very simple one, for the action of the machine is almost automatic. The operator has only to place the ends of a ring of material in position in the dies and depress the treadle of the machine. The time of handling the rings into and out of the dies is much greater than that needed to complete the stitching.

Pressing the Rings to a Final Shape

The last mechanical operation on the clutch rings is compressing them to uniform thickness and is performed in heavy toggle presses. The tools for this work are made as carefully as for a sheet metal drawing operation and are of much the same construction. As the pressure upon the ring reaches a maximum of several hundred tons it is necessary to confine the material from all sides in order to prevent it from flowing out of shape.

The body of the die is a round block of steel, in the upper face of which is an annular recess with major and minor diameters equal to those of the outside and inside of the ring respectively. Accurately fitted to this recess is a ring of steel that rests upon coil springs in cells at the bottom of the recess. The thickness of the steel ring is less than the depth of the recess by an amount that is slightly greater than the thickness of the ring of material to be pressed. The punch is, of course, a counterpart of the ring. When the press is operated to make a hit the material is confined in all directions.

Installation and Maintenance of Ball Bearings

By H. N. Parsons
Chief Engineer, Strom Ball Bearing Manufacturing Co.

Care in handling — Instructions covering application — Removing and cleaning bearings—Lubricants; the kinds to use and the kinds to be avoided and the reasons therefor

A BALL bearing, while simple in construction, is highly developed in quality of materials, accuracy of dimensions, fineness of finish and precision in fitting of balls in the races and retainers. It is, therefore, quite sensitive to outside influences that affect its operation, and it demands the exercise of care and good judgment in its handling, application and maintenance.

It is the purpose of the following to point out a few common-sense and easily-applied principles and practices in the handling, application and maintenance of ball bearings, which, if adhered to, will result in efficient and reliable service.

A ball bearing as shipped by the factory has been thoroughly cleaned, covered with corrosion-preventing lubricant, wrapped in moisture proof paper and packed and sealed in a tight package. In this condition it is ready for installation. It is not necessary to clean off the packing lubricant. Before attempting to mount the bearing, check all housing bores and shaft diameters for correctness of dimension and roundness.

Precautions in Mounting

When everything is ready to mount the bearing, remove it from its package and place it on the shaft. Use a little oil on the bearing seat. Generally, the inner race of an annular bearing should be mounted on the shaft with a light drive fit, if it is locked between a shoulder and a lock nut; or a press fit, if there is no other provision for locking to the shaft. In consequence of this, the bearing should be mounted by driving or pressing it on the shaft. If it is to be driven on the shaft, start the bearing squarely by hand and start tapping, using a soft metal rod between the hammer and the face of the inner ring. Tap equally around the circumference. An iron pipe, fitting over the end of the shaft and lined on its face with a leather washer, is a very handy tool for driving the bearing onto its seat. If the bearing is hard to start, it may be slightly expanded by placing it in hot oil. A temperature of 300 deg. F. should not be exceeded. When the bearing has been driven home, screw the nut down tightly so that the inner ring fits well up against the shoulder, and lock the nut with whatever means has been provided.

Do not hit a ball bearing with a hammer. The race rings are hard and will break under a direct blow. Always use a brass or soft metal rod against the face of the inner ring, and tap lightly. Heavy blows tend to cock the bearing and cause it to dig into the shaft and score it. Equal taps on all sides, or even pressure by using a tube, will send a bearing squarely to its seat. The use of a soft hammer of babbitt or lead is not to be encouraged because of the possibility of chips breaking off and falling into the bearing. A hard-wood block of convenient shape will give good results. Never hit the balls or retainer or the bearing will bind and retainers may be broken.

For short shafts, use an arbor press for pressing the bearing on the shaft. Always see that the bearing starts squarely on the shaft, and that the shaft is clean. Squirt a little machine oil on the bearing seat.

How the Bearing Should Fit

Generally, an annular ball bearing fits into the housing with a push or sucking fit. This means that it can be pushed in or out of the housing by hand, without tapping or hitting. If the ring should become cocked at the start, do not force it. Pull it out or tap it out from the rear, and begin again. Put a few drops of oil on the outer ring to make it slide easier. Never hit the inner ring of the bearing when pushing it into the housing.

When removing ball bearings from shafts and housings, the same principles and methods of procedure apply as outlined before. Many ball bearings can be used again, subsequent to repairing and overhauling of a machine, and care must be exercised in removing them so that they will not be damaged.

The housing cap should be removed and surplus lubricant taken away. Unlock the locking device on the shaft nut and unscrew the nut. The inner or shaft ring will be found seated firmly on the shaft, and it will have to be driven off. The pressure to drive off a ball bearing should be as close as possible to the portion that is tight, either on the shaft or in the housing. Generally, the shaft ring is tight on the shaft, and the pressure should be applied to it. Do not make the mistake of hitting the outer ring of the bearing in trying to drive it off the shaft. This will injure the bearing. Use a bearing puller. If there is none at hand, take a brass or other soft metal rod, place its edge against the inner ring of the bearing, and then by tapping the rod with a hammer and shifting the rod to opposite points of the ring, gently drive the bearing from its seat. Be careful not to cock it. If, for lack of lubrication, the ring has become frozen to the shaft, squirt some kerosene on the shaft and let it soak. Whenever possible,

support the shaft in a vise, the jaws of which should be covered with leather or sheet brass. Let the edge of the inner ring of the bearing rest on the edges of the jaws, and drive the shaft out by tapping on its end with a hammer. In installations where the shaft and bearing cannot be pulled from the housing, a puller of suitable form must be used to pull the part in which the bearing is mounted and the bearing itself from the shaft.

When the bearing has been mounted in the housing and locked on the shaft, put in enough grease, if grease is used to lubricate, to fill the housing about one-third full. If oil is used, squirt a little into the bearing and replace the cover cap. See that the cover screws down completely and that the faces of the cover and housing meet. If the lip of the housing cover bears against the bearing, the end clearance is not correct, and the bearing will be cramped if the housing cover is forced to its seat. If shims are used to secure the proper bearing end-clearance or bearing adjustment, see that there are a sufficient number of them and that they do not lap or fold over one another. After assembly, try the shaft. If it turns freely and has a tendency to spin, the bearings are free and a good job has been done. If the shaft drags, there is some interference which must be discovered. The bearing may be pinched if the housing is split. It may be cramped if the end cover bears against it. Some projection may be striking or the bearing seals may fit too tight on the shaft.

Mounting Angular-Contact Bearings

Angular-contact bearings, designed to take appreciable end-thrust loads, must be mounted so that the thrust action in the two bearings supporting the shaft is opposed. There must be no end motion in either the shaft or the bearing assembly, and the bearings must be adjusted endwise or laterally very carefully. To secure this adjustment, the bearings should be mounted so that the shaft ring is slidable in the housing, its lateral location and adjustment secured by screwing the end cap or cover-plate bearing against the race ring face, or by means of shims interposed between the cover and the face of the ring.

Over adjustment of angular-contact bearings is as dangerous as under adjustment, which latter is manifested by a loose assembly and end motion of the shaft. Over adjustment will overload the balls in the bearings and cause early destruction. The correct method of adjusting, is to screw up until there is no shake or looseness in the assembly and the shaft is free and comes to rest without jerk.

When ball bearings have been removed, they should be thoroughly cleaned. Kerosene is an excellent cleansing medium, and should be clean and kept in a clean container. The bearing can be flushed out by hand by dipping it in the kerosene and sloshing it about. Movement of the ring should be started very slowly and brought back and forth a number of times before being spun. This will allow dirt and grit to be flushed out before it is ground into the bearing by spinning. A more elaborate arrangement for cleaning a large number of bearings may be provided by clamping a vessel containing kerosene to the faceplate of an old drill press. Mount a hook in the chuck on the drill-press spindle on which the bearing can be hung. When the spindle and bearing are lowered into the kerosene, the spindle can be revolved by power, and the bearing thus thoroughly flushed.

Lubricants of a mineral base only should be used for lubricating ball bearings. Greases containing alkali, or that become rancid with age, will corrode the highly polished surfaces and hasten the early destruction of a bearing. Lubricants must be free from contamination by foreign matter, such as dirt and grit, and must not contain moisture. Cleanliness is the ever governing watchword in the maintenance of ball bearings. It must be remembered that the balls are fitted in the races with an accuracy gaged and measured by 0.0001 in. Sand or dirt of any kind will act as an abrasive, cause the bearing to wear rapidly and soon render it worthless. Therefore, keep the cover on the retainer and keep the grease guns or oil funnels clean. Once a year, at least, ball bearings should be cleaned. The old lubricant should be emptied from the housing, and the housing thorouhgly flushed out.

For high-speed shafts, the best results are obtained by the use of light and medium mineral oils. Greases and heavy oils give best service for slow or heavy duty work. Heavy oils are more satisfactory for housings enclosing gearing supported on ball bearings.

Avoid graphitic lubricants as far as possible. Graphite, if very finely deflocculated and added in proper proportion to a grease or oil is an excellent lubricant, in that it forms a tough and enduring film over the metallic surface. For this reason it is highly recommended for the lubrication of gears and some forms of sliding bearings, as it fills in the interstices in the bearing surfaces and allows the true lubricant to operate efficiently. As applied to ball-bearing lubrication, however, its value is at least doubtful, and quite often decidedly detrimental results have been obtained. Graphite tends to wear the ball and groove surfaces by lapping them. This is not due to the graphite itself, but to impurities, foreign matter and abrasives it contains. The use of graphite for ball-bearing lubrication cannot be recommended as beneficial, and its application is purely a question of economics. Its use is advisable only if the increased efficiency and life of other wearing parts subjected to graphitic lubrication, offset the possible harmful effects of such lubrication on ball bearings.

The Detection of Flaws by Magnetic Analysis

As previously mentioned in the Bulletin, the Bureau of Standards has been engaged for some time in a study of the magnetic method for the detection of flaws and defects in steel, with particular reference to wire hoisting ropes, according to *Technical News Bulletin* No. 96. The economic value of such a nondestructive method would be very great. Many investigations along this line have been made at the Bureau.

Experiments have recently been made at the Bureau to discover the cause of this uncertainty, and a method of eliminating it. It has been found that the greatest source of difficulty is the effect of variations in internal stress within the specimen. Such variations give rise to large differences in magnetic permeability, which produce effects similar to and often greater in magnitude than those caused by the flaws in the material. The results of recent experiments show that by the use of higher values of magnetizing force than have heretofore been employed, the effect of internal stress is greatly reduced without a corresponding reduction in the effect of flaws.

Birmingham Shops of the Southern Railway System

By Howard Campbell

New buildings and up-to-date equipment feature the Finley shops—Several good milling set-ups—Special tools for frequent jobs

ONE of the outstanding events of railroad history in the United States during the last year was the opening of the Finley shops of the Southern System at Birmingham, Ala. All of the buildings are new, and they are equipped throughout with new machinery of the latest design.

The shops consist of a 25-stall roundhouse and a T-shaped structure containing, in the vertical section, the machine and erecting shops, while the horizontal section houses the blacksmith shop, flue-shop and boiler shop. The erecting bay is of the transverse type and contains 24 pits. It is served by a five-track, 250-ton motor-driven transfer table outside the building while, on the inside, a 150-ton electric crane and two 15-ton electric cranes handle the work. Two cranes of the latter type also serve the machine bay, traveling the entire length of the building. The erecting shop opens directly into the boiler shop and the crane tracks extend across the boiler-shop so that work can be handled back and forth between the two departments. The wall that divides the machine shop from the blacksmith shop is open at the top and center, as shown in Fig. 1, so that work can be handled by crane between these two departments.

The blacksmith shop is equipped with the latest type of forging machines, steam hammers, oil furnaces, bulldozers, punches and shears. The twenty forges are aligned back to back in two rows of ten each, the uptakes leading to a common outlet at the top. A blower system keeps the shop practically free from the smoke that prevails in most blacksmith shops.

A gallery extending the entire length of the machine shop, opposite the erecting floor, provides roof for the air-brake department, tool-room, electrical department and general foreman's office, which is so located as to command a view of the entire shop.

One of the modern machine tools with which the shop is equipped is the Ingersoll vertical milling machine shown in Fig. 2. The operation of milling the end of a side rod has just been completed, a 5-in. diameter inserted- tooth cutter being used for the job. One-quarter inch of stock was removed, the cutter running at a speed of 24 r.p.m. and feeding ¼ in. per minute. The job was completed in approximately two hours.

Slab-milling operations on side and main rods, dies and other large work are performed on the Ingersoll mill shown in Fig. 3, using a 9x20-in. inserted tooth cutter. Valve strips are machined, valves are slotted, shear blades are milled and other similar operations are performed on a No. 4 Cincinnati milling machine, Fig. 4 showing it set up.

A Libby lathe, designed especially for railroad work, is shown in Fig. 5, turning and threading a forged-steel knuckle-pin. The tools are ¾x1-in. high-speed steel, located in a box which also carries the rollers that keep the tools from springing away from the work. One of the tools is taking a 1⅛-in. cut with a ⅛-in. feed at a speed of 64 r.p.m., a heavy flow of compound serving to assist the cut. The piece is turned and threaded complete in 18 minutes. A "Modern" die is used for the threading operation.

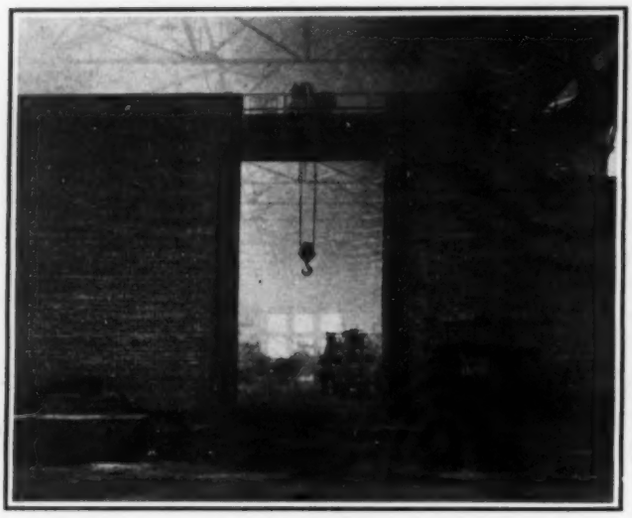


Fig. 1—Looking into machine department from blacksmith shop

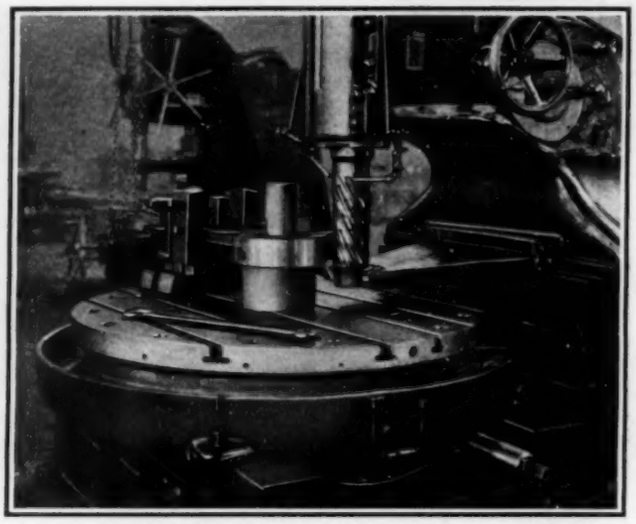


Fig. 2—Side rods are machined on the Ingersoll rotary machine

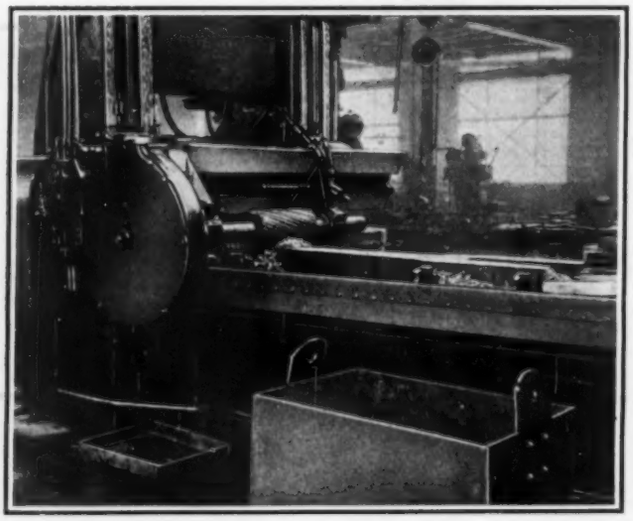


Fig. 3—Main rods are slab milled on this machine

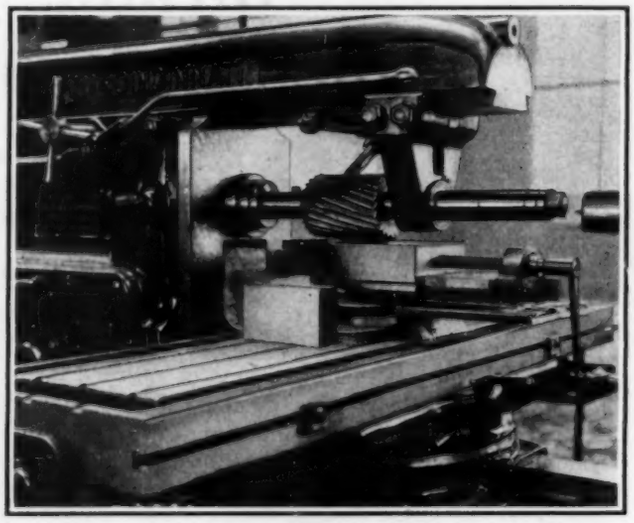


Fig. 4—Milling valve strips

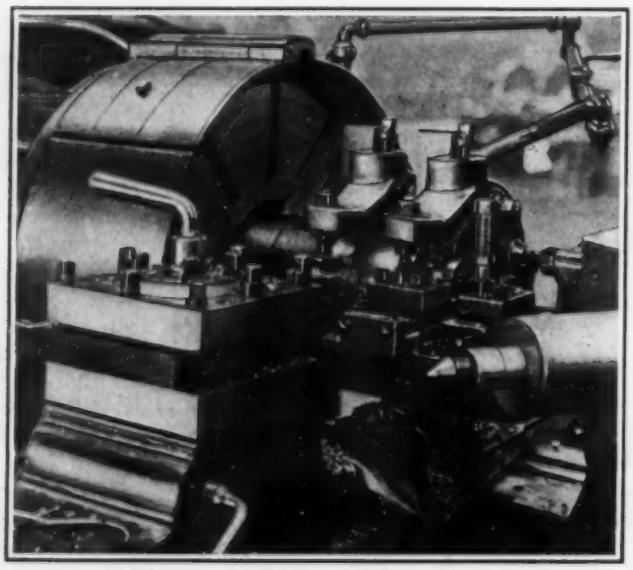


Fig. 5—Turning knuckle pins

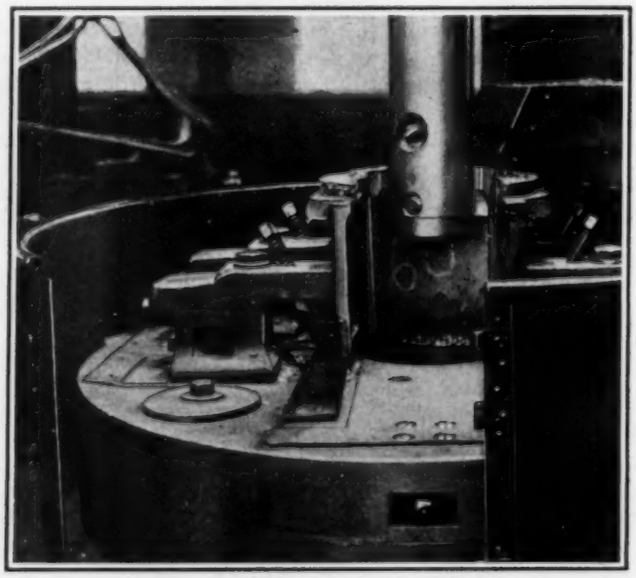


Fig. 6—Boring and facing a driving box

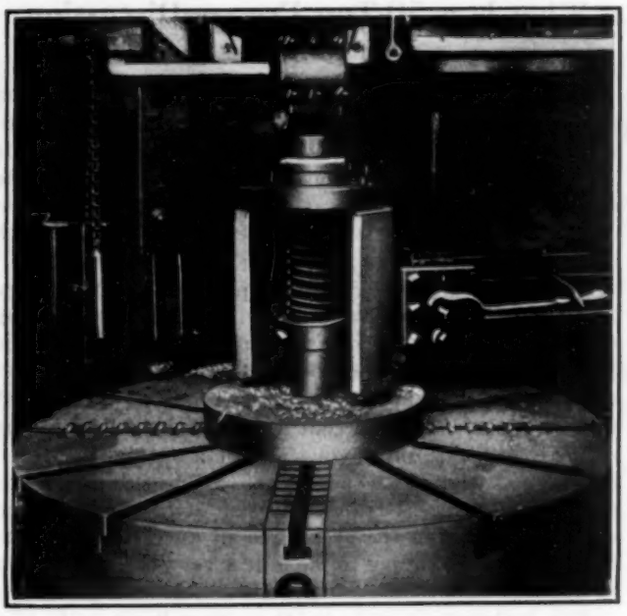


Fig. 7—Turning a journal brass

Driving boxes are bored and faced in the Sellers boring mill, Fig. 6. The machine is equipped with a special chuck for holding the work, as shown, and a Davis boring bar which is incorporated as a part of the machine. The bar is thus equipped with the Davis patent adjustable tools, which can be quickly and accurately expanded or contracted by thousandths of an inch. The boring tools remove $\frac{1}{16}$ in. of stock from each side of the hole, feeding $\frac{1}{8}$ in. per rev., while the piece revolves at a speed of 49 r.p.m. At the same time a 1x1$\frac{1}{2}$-in. tool in a horizontal arm advances and faces off the lateral surface. The piece is bored, faced and filleted, all in 10 to 12 minutes, from floor to floor.

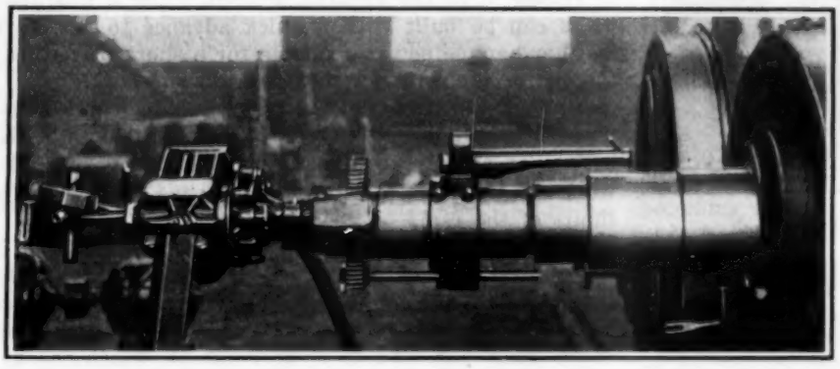


Fig. 8—Portable crank-pin turning-tool

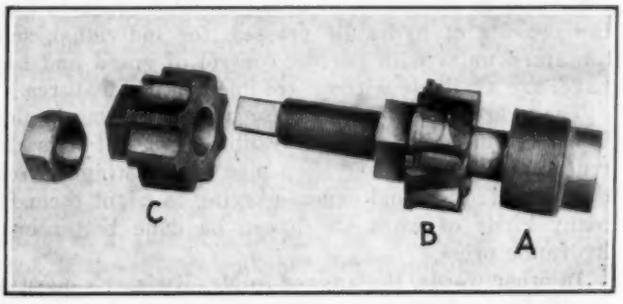


Fig. 9—Tool for re-conditioning injectors

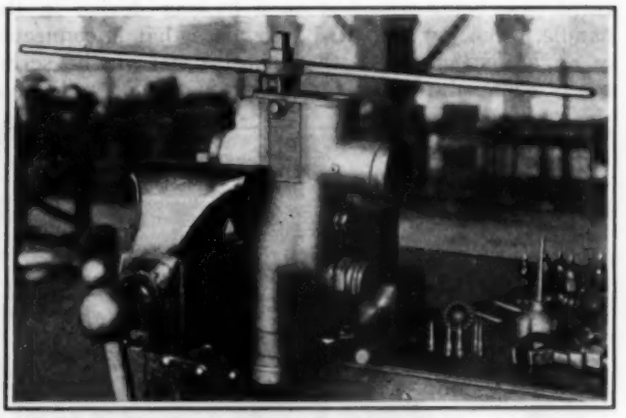


Fig. 10—Injector with tool in position

Journal brasses are turned in the Bullard boring mill, Fig. 7. The piece is held in a fixture that consists of a round plate, bolted to the machine-table, from the center of which rises a shaft that carries the top plate of the fixture and a nut by which the top plate is held in position. A spring under the top plate keeps it up when the fixture is empty. The piece rests on three cap-screw heads in the bottom plate and is held firmly in position by corresponding screws in the top plate, the screws being adjustable to take care of variations in the castings. Circular lines in the bottom plate, at half-inch intervals, serve as guides for truing up the piece and centering it before it is clamped down.

A $\frac{3}{4}$x1$\frac{1}{4}$-in. high-speed steel tool is used, which removes from $\frac{1}{16}$ to $\frac{1}{8}$ in. of stock while the piece revolves at a speed of 60 r.p.m. A $\frac{1}{32}$-in. feed is used and the piece is finished complete in 30 minutes.

A portable tool for turning crank-pins is shown in use in Fig. 8. A heavy shaft carrying the tool-holder, is the axis of a gear that is driven by a pinion, the shaft of which fits into the spindle of an air-motor. One end of the gear-shaft is attached to a sleeve that can be slipped over the end-fit on the crank-pin and locked there, while the other end revolves in a journal in the frame that holds the shaft, gears and air-motor together. The toolholder is clamped in a ring that is keyed to the shaft so it slides longitudinally. The shaft revolves at 18 r.p.m. and the tool feeds $\frac{1}{16}$ in. per rev., while taking a $\frac{1}{32}$-in. cut. If the pin is not badly worn, it can be turned in two hours.

The tool shown in Fig. 9 is used to convert the types 10 and 11 injectors into the 11-*A* type. The threaded plug *A* screws into the body of the injector where the type 10 seat is removed, the plug acting as a guide for the cutter *B* and tap *C*. The cutter is slipped over the plug as shown in Fig. 10 and is used to face off and enlarge the fit of the bonnet to standard size. The cutter is then removed and the fit is tapped. A false brass seat can then be put in and re-seated.

To facilitate the removal of gage-glasses, the tool shown in Fig. 11 has been developed. The frame of the tool is Y-shaped, the vertical section forming the handle. At the end of each arm is a small jaw, the

third jaw being attached to a locking device in the handle. The jaw is bolted to a piece that is connected to an adjusting screw, the opposite end of the screw being clamped to the handle by means of a thumb-

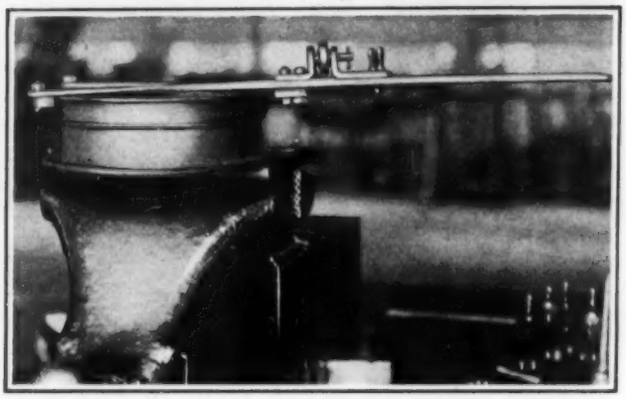


Fig. 11—Tool for removing gage glasses

screw. A slot in the handle provides for moving the jaw as required. The gage is set on a plate that has two bolts in it by which it is locked in a vise, the plate carrying two small pins that project far enough to enter the screw holes in the flange. The tool is quickly

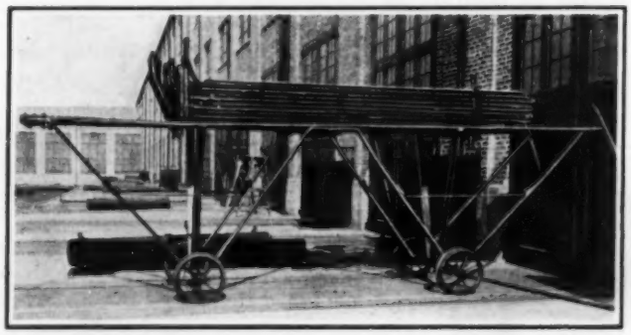


Fig. 12—Rack for superheater units

adjusted and easily operated, and reduces a difficult job to a simple one.

A rack for holding superheater flues so that they can be more easily handled to and from the locomotive is shown in Fig. 12. The main frame is of 1x4-in. iron, braced with $\frac{3}{4}$x3$\frac{1}{2}$-in bars.

Workmen's Efficiency and Waste Elimination

William Green, president of the American Federation of Labor, declared at a recent meeting of the National Civic Federation that labor believes production costs should be lowered through the promotion of efficiency in workmanship and management, the elimination of waste and the introduction of economy processes. Unreasonable competition is one of the primary causes of waste, leading even to a disregard of human life and human welfare. He cited a great basic industry in which, as the result of competition, there is at present shocking disorganization and human suffering. Since labor organizations cannot be destroyed why not, he pleaded, "recognize their value and merit and accept from them the benefits they can give through their organized effort?"

What Is a 50-Ton Press—Discussion

By J. P. Ferris

The difficulties encountered by Mr. A. Kwizzer on page 376, Vol. 62, of the *American Machinist* in deciding what the capacity of a mechanical toggle press is in hard figures arouses my sympathy, and causes me to offer for his consideration a comparison between some of the characteristics of presses of this kind with hydraulic presses.

A mechanical press depends upon taking the energy stored in the flywheel and applying it to the work by means of a crank. Mr. Kwizzer calls attention to the fact that the force which he can obtain from the press depends on the exact angle of the crank at the instant it strikes the work, and that a great many other things make it difficult for anyone except a specialist to discover just what he can expect. Such things as the stretch of the press frame, the size of the flywheel and of the belt driving the press, are all uncertain elements to him, which combine to make it a very difficult matter to discover just what such a press will do on a given job.

The hydraulic press, on the other hand, will give any desired stroke without any change whatever in the force available. In other words, the thick shearing job of which Mr. Kwizzer speaks can be done perfectly well with any hydraulic press which will shear the same cross-sectional area of metal in a thinner plate, and the speed of the ram to the work is the same at all points.

A mechanical press must have a large flywheel in order to store energy during the idle part of the stroke to release it at the moment desired, while a hydraulic press can be built with a quick advance to the work and have ample power available for a short travel near the end of the stroke without any flywheel.

Further, the stretch of the frame in a hydraulic press does not affect the pressures available as it does at the bottom of the stroke of a mechanical press, since the work can be set in the former far above the low travel limits of the ram.

It takes a man who knows all about presses, and is a good deal of a mathematician to boot, to calculate the tonnage exerted by a mechanical press on a given piece of work. As long as the press does the job the user rarely finds out. There is no point on which the hydraulic press shows up more favorably than right here. The gage on a hydraulic press shows the tonnage required, not only for each different job but for each individual piece, and the user has the opportunity of tabulating each job in the shop without any trouble, in order to compile data to guide him on future work.

A great many people hesitate to use hydraulic presses because of troubles with accumulators, valves and packings on pumps. The mechanical public is no longer compelled to endure these annoyances in order to have the benefits of hydraulic presses, for individual, self-contained units with perfect control of speed and tonnage, are available without trouble-making features.

There are plenty of uses for which the mechanical is better suited than the hydraulic press, but it is also true that engineers and shop men are wasting a great deal of ingenuity and expense trying to adapt them for many kinds of work which can be done better on a hydraulic press.

In other words, the answer to Mr. Kwizzer's question is, "Before selecting a mechanical press investigate the possibilities of doing the work hydraulically."

Training, Developing and Promoting Foremen

By Louis Ruthenburg
General Manager, Yellow Sleeve Valve Engine Works, Inc.

The departmental business manager—Training from his point of view—The case of old Bill Jones—Development preliminary to foremanship—Basing promotion on established ratings

THE subject of training, developing and promoting foremen is of such magnitude and importance that I am deeply conscious of my inability to do more than relate something of my own experience and tentative conclusions and ask you to accept what I have put down as nothing more than one man's attempt to contribute his mite to a philosophy which, so far, has achieved only embryonic development.

I want to deal with this foreman matter, not from an idealistic nor from a theoretical viewpoint, but primarily from the viewpoint of the man charged with the responsibility of building and maintaining a permanent and profitable manufacturing institution.

First, let us attempt to determine if foreman training, systematically planned and administered, is desirable. One way of approaching this phase of the question is to establish as nearly as possible what a foreman should be, then define what he actually is. If a tangible difference exists between the ideal foreman and the average flesh and blood article, we shall have established the desirability of training. Later we can discuss the feasibility of such training.

As manufacturers, our objectives are permanence and profits. Given a salable product, a competent selling organization and sufficient financial strength; permanence and profits depend upon the high quality and low cost of the product as compared with the quality and cost of competitive products. Good foremanship is a most important factor in establishing and maintaining high quality and low cost.

Progress in Industrial Development

The complexity of manufacturing organization has increased at a prodigious rate. And while we have been adding planning departments, complicated incentive payment systems supported by time and motion study, departments of maintenance and supply, employment and personnel divisions, organizations for designing, making and distributing tools, elaborate systems of inspection, and many other complexities, our shop foremen have been relieved of responsibility, supplied with a beautiful set of readymade alibis but given mighty little real training and information. Industrial development has run away from foreman development.

Isn't it a fairly sane idea to tell those foremen "what all the shootin's about" and, incidentally, to once more hold them responsible for the operation of their departments? It is highly desirable that we retain the great advantages of functionalized plant control and at the same time reduce overhead charges to a minimum. I know of no method of attaining this objective so directly, so inexpensively and so constructively as by properly training departmental foremen.

The Foreman's Position

Before we ask the departmental foreman to assume full responsibility for the operation of his department; before he is asked to get results from co-ordinate departments which cannot be placed directly under his authority, we must realize that we are about to ask him to assume a very complex responsibility. In short, we are about to ask our foreman to become the "business manager" of his department. This presupposes a high type of ability and much knowledge that the foreman could not possibly have acquired as a workman at the bench or at the machine, nor absorbed at random since becoming a foreman.

As business manager of his department our foreman must have certain rather definite qualifications. He should be a good workman—a master craftsman. The value of the practical, hard-headed "know-how" must always be kept definitely in mind. But this technical knowledge alone is not sufficient. In fact, some of the usual characteristics of the highly skilled craftsman operate against his success as a foreman. The modern foreman must know many things and practice many arts that were not dreamt of in his philosophy as a skilled workman.

He should have a practical working knowledge of the history and evolution of modern industry so that he can reason for himself why certain things are done in certain ways and be able to evaluate, originate and apply new methods.

He should have some practical knowledge of manufacturing economics and accounting, a clear insight into such overhead items as equipment depreciation, tool cost, scrap charges, supply costs, supervision and inspection charges and the like in their relation to direct labor charges and total costs.

More important, possibly, than any other part of our modern foreman's equipment is a good working knowledge of human beings. He is expected to maintain high labor efficiency in his department. Therefore, he should know how to select and train and keep good men under

An address delivered at the annual convention of the National Metal Trades Association, held April 22 in Cleveland, Ohio.

his supervision. Qualifications for leadership and teaching ability are of great importance.

Knowledge of these things and of many others should form a definite part of our modern foreman's mental equipment.

Now, having to some extent defined the qualifications of the ideal foreman, let us examine the qualifications of the average foreman. We find that he is a skilled craftsman, endowed with a little more intelligence and ambition or "guts" than his fellow workmen, all essential characteristics in a good foreman. But without systematic training his knowledge of industrial principles, of simple economic values, of dealing with the men in positions subordinate, co-ordinate or superior to himself must be non-existent, instinctive or accidental.

By subtracting the qualifications of this average foreman from those which we have outlined for the ideal foreman, we can easily establish the fact that some form of systematic and comprehensive training is at least desirable. Having established the desirability of foremen training, let us consider a moment its feasibility.

I take it to be a truism that whatever has been accomplished under given conditions may, under the same conditions, be repeated, and that a certain accomplishment may possibly be repeated under differing conditions by suitable adaptation of methods.

There have been so many instances of successful foreman training, success being gaged solely by reduced cost and improved quality of product, that about the only doubt a manufacturer can have as to the feasibility of training must be fathered by the thought that conditions in his plant are "different."

Naturally, results will vary greatly under different conditions, but the results that may be expected as a result of sound training under almost any set of conditions are so decidedly worth while that a careful survey and possibly a little experimentation are justified to discover just what you may reasonably expect to accomplish under your own peculiar conditions by methods properly adapted to them.

Training Is Entirely Feasible

I know there have been many attempts at foreman training which have either failed or produced indifferent results. These failures prove little except that wrong methods were employed. The fact that after innumerable attempts I can't drive a golf ball three hundred yards does not prove conclusively that it cannot be done, nor even that I cannot learn to do it. It simply proves that I have not learned to apply the proper principles.

And just as there are certain principles which I must master before I can hope to drive that ball successfully, there are certain principles involved in foreman training which must be observed, if satisfactory results are to be attained. I cannot drive a golf ball very far with the wrong end of the club. Neither can we force knowledge into a man's being. Education is a "leading out" process, not a "forcing in" operation. And many attempts at foreman training have failed because this elementary principle has been disregarded.

Do you remember how we tried it in the rush days of '19? Business was booming. Materials were scarce, transportation was terrible. Costs were shooting up. Labor turnover was enormous. We didn't know just what had to be done but we knew that something was lacking. Along came a salesman peddling a "Foreman's Training Course" (a pretty good course too, as far as that is concerned). He sold us the idea and we generously decided that the company would share the cost of the course with the foremen.

We immediately called a meeting of the superintendent, employment manager, and all the foremen. We told our foremen that we were going to teach them foremanship! Then we turned the whole thing over to the superintendent and the employment manager and went back to appeasing customers, jacking up sources of supply and cussing the railroads.

The Case of Old Bill Jones

Did it work? It did not! Consider, for example, the case of old Bill Jones who had been foreman of the turret lathes for the past six or eight years. Without warning or preparation the boss had said to him, "Bill we're going to give you a chance to learn foremanship. Look, here's a book written by Professor Hibrow." Inasmuch at it was the boss talking, Bill didn't talk back. But without any doubt Bill knew the boss was temporarily insane. Where did he get that stuff? Teach him foremanship? Why, hadn't he been holding down a foreman's job for years? And he'd like to see the bird that could tell him about turret lathes!

Certainly Bill sat in on the classes. He figured that a foreman had to put up with a lot of damfoolishness in his shop, anyhow, to keep from getting in wrong, and as long as the rest of the bunch stood for it, why should he pass up a good job? But learn anything? Say, don't make him laugh! You don't learn how to be a foreman out of a book. What do these white collar birds know about making a bunch of bums get production out of a string of turret lathes, anyhow?

With such a lack of receptiveness on the part of the men to be trained is it remarkable that the result of foreman training has, in some cases, left much to be desired? It may be taken as a rule that until an attitude of enthusiastic receptiveness exists or has been created among the men to be trained, attempts at training will produce disappointing results.

Then it must be remembered that the best training results can only be expected under able leadership and strong personal inspiration. It should be generally recognized among the foremen that the general superintendent or the works manager or the vice-president in charge of production, or even the general manager or the president himself, are enthusiastically interested and believe firmly in the project. A leading company official should take enough time to understand the matter, talk to the foremen about it and supervise the program.

Foreman training is of vital importance to the organization. It is a man's job. Although the routine work must be delegated in large part to an able subordinate, this subordinate must have the boss's enthusiastic support and help. The company official who gives this matter his attention must be above all a practical manufacturing man. In this particular matter, your foremen are usually, and for obvious reasons, uncertain of leadership of other types.

Then be sure that your routine lecturer is a real teacher. He must command respect for his knowledge and ability. He must be able to explain abstract principles by concrete illustration. He must know your organization methods intimately. Other able speakers on special subjects should be engaged to relieve him from time to time.

Enlisting the enthusiastic interest of the foremen, strong leadership and able teaching personnel are all of primary importance. Initially, at least, method is more important than text matter. "How" takes precedence over "what."

In selecting or preparing text material and lectures it should always be kept distinctly in mind that, while we are endeavoring to teach principles, we are dealing with an average mind which thinks in concrete terms and therefore finds it difficult to absorb abstract ideas. Consequently every principle or abstract thought presented must be immediately, and as graphically as possible, illustrated by some concrete practice or parallel with which all the men in the class are familiar.

The average foreman is not a readily acquisitive student. He probably quit school about the seventh or eighth grade and his reading since that time has been more or less confined to headlines, the sport sheet and the *American Machinist*. Hence the need for vivid, practical illustration such as can best be drawn from your own plant practice.

If you do not prepare your own text material, you must depend upon your lecturers and teachers to impress the principles and facts set forth in the text by means of graphic examples drawn from specific practice with which the foremen are intimately familiar. The initial text material and lectures may well deal with the evolution of industry, starting with the story of individual craftsmen and their guilds, cottage industries, the change wrought by the great inventions of a century ago, tracing division and subdivision of labor, ever increasing specialization to the modern system of functionalized control.

From this beginning it is an easy transition to an explanation of modern methods of processing, plant layout, machine-load analysis, stock control, planning, incentive method of wage payment, time study, job analysis, methods of selecting and teaching efficient workmen, or any subject matter that may appeal to you as being a desirable part of your foreman's knowledge and mental equipment.

Organizing the Course

Let your text matter present definite information as interestingly as possible. Inspirational preachment should be injected sparingly, if at all. It is probably safer to depend upon a verbal spell-binder if such spiritual food is considered indispensable.

The successful application of such methods and text material as I have described has been demonstrated in large organizations. Similar methods have been used successfully for training groups of foremen from small and greatly diversified industries.

When training is soundly started with any group, it has a tendency to be self-perpetuating in interesting and constructive developments. To cite only two examples with which I am intimately familiar: Foremen and superintendents at the Delco plant in Dayton have continued their classes with great enthusiasm and profit for five years, advancing each year to new and interesting studies of industrial subjects and a class of less than one hundred foremen from diversified industries which met in the Dayton Y. M. C. A. five years ago has evolved into the Ohio Federation of Foremen's Clubs, a wonderfully fine organization of over three thousand men.

Training the foreman after he has become a foreman in name presents some interesting and difficult problems because we are trying to add certain qualifications which the man should have had before he was given his foreman's job. He should have attended an intensive training school after he had thoroughly learned his trade and before he was put in charge of men. Let us examine one or two successful attempts to establish definite training in foremanship preliminary to assignment to supervisory jobs aimed to cause prospective foremen to serve apprenticeships in foremanship.

The Flying Squadron

A number of years ago the Goodyear Tire and Rubber Company organized what is known in their plant as the Flying Squadron. This organization has for its membership men who show promise of developing into successful plant executives. They are imbued with the high ideals of the company. They are thoroughly grounded in all phases of processing, plant routine and in the fundamental principles of successful manufacturing. When men are graduated from the Flying Squadron into minor foremanships they have built foundations capable of sustaining successful careers.

A similar plan has been in effect for some years at the Dayton Engineering Laboratories plan. The scheme is quite simple. Candidates for the Squad are usually drawn from among the departmental job setters or from applicants who have had technical school training. With two thousand people on the factory payroll there are usually six or eight men on the Squad. Foreman turnover at Delco is very small.

The squad men are trained in motion study, rate setting, stock handling and accounting and other duties by being assigned to jobs in these departments. They are given definite training in foremanship in which they are required to read certain text material, attend lectures and pass examinations. When a vacancy occurs, one of these men is usually given the position. Squad graduates almost invariably become successful foremen. If a man's characteristics are such that he cannot become a successful foreman he is eliminated long before graduation and promotion. It costs a great deal of money to hire and fire foremen. The fact that careful training greatly reduces foreman turnover has been very completely demonstrated.

Some six years ago I had the good fortune to establish contact with Doctor Walter Dill Scott and his able staff immediately after their very interesting personnel work in the army had been given pause by the signing of the armistice. Under the immediate direction of Doctor J. W. Hayes, we set out to discover whether methods similar to those which had been so successful in the army had any considerable value in our industry.

Among other requirements, a scheme of executive rating very similar in principle to the army plan for officer rating was developed. This has been continued as a means of foreman rating. There are seven qualifications considered under this scheme, namely:

Appearance and Manner
Technical Ability
Initiative
Leadership
Planning Ability
Co-operativeness
Ability in Developing Men

The division superintendents rate each of their foremen and job foremen under this plan every six months. Frequently they ask the general superintendent to make independent ratings as a check upon their own. The

foremen are told in a friendly and helpful way just how they fall short of perfection.

The rating scheme is analytical. It reduces the influence of prejudice and is the means of up-grading and developing the foremen by placing their deficiencies frequently before them. When promotions are to be made the ratings of the candidates have a very considerable influence on the choice.

Mental alertness tests are used as another means of choosing candidates for the squad and as a supplementary method of rating foremen.

While such methods as these are of great value in large organizations, where it is impossible for one executive to maintain close personal contact with all foremen and department heads, they are not without interest in smaller organizations as a means of checking the boss's opinion of the men with whom he does have close contact.

Most of us are willing to admit that we have a sort of God-given intuition that permits us to choose good men for responsible positions. Some men undoubtedly do have a natural gift or a cultivated ability for sizing up capabilities in other men with uncanny accuracy. But with most of us, our pride in ability to pick winners is the result of remembering our successes and forgetting our failures. When we try to set down definite reasons for thinking a man will be a winner or a dud in a future position, we often find that our opinions and prejudices are not entirely dependable.

Most of us buy pig iron or steel or fuel to definite specifications subject to analysis by our own laboratories. Isn't it at least equally important to select and promote men under specifications as nearly exact as it is possible to define them and subject to analysis as accurate as the undeveloped state of the art permits?

I believe that we are about to experience an industrial era in which human relationships will receive an ever-increasing amount of constructive attention from industry's ablest leaders. In this era the training, development and promotion of plant executives will be frequently in the thoughts of plant managers upon whom devolves the responsibility of building and maintaining permanent and profitable manufacturing institutions.

Getting the Most Out of Your Machine Tool Dollar—Discussion

By H. J. Hart
Superintendent of Works, Pittsburgh Engineering Works

THE writer has read with a great deal of interest the article by J. A. Smith, under the above title on page 409, Vol. 62, of the *American Machinist*, dealing with maintenance of machine tools and other equipment in the General Electric shops. I see absolutely nothing to criticise on the statements made by Mr. Smith, concerning the work in his shops. However, his shops are different from those doing a small machine-building business, such as ours, requiring a variety of machine tools, none of which are kept continuously busy, many set-ups and a small amount of production work.

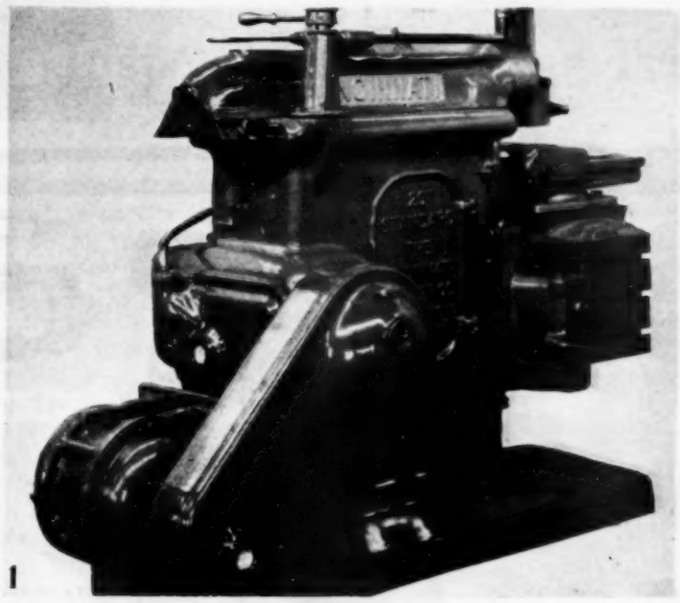
We have found that it pays us to thoroughly overhaul our machine tools and reinforce the weak spots, particularly regarding lubrication. It has been our experience that almost all machine tools, as furnished by the manufacturers, lack provision for proper lubrication, many of them having a number of small uncovered oil holes. Very few machines are provided with wicks in the oil holes or provision to filter out any grit fed in with the oil. Still fewer are fitted with felt for distributing the oil and wiping off cuttings or "frettings" of the journals, so as to prevent "galling." These defects are usually simple and can be easily remedied by a small amount of patience and persistency on the part of the owners.

We also find that some parts on new machine tools are not properly heat-treated or hardened. We take out parts that are subjected to wear or strain, and case-harden or heat-treat them correctly, thus greatly prolonging their wearing life and accuracy. It is our rule, whenever machines are overhauled, to chamfer off the corners of gear teeth to a radius equal to one-half the tooth depth and to file all burrs or sharp edges on the teeth or other wearing parts.

In addition we fit our machine tools with individual-motor drives, permitting no line or countershafts. In some cases it is advantageous to fit machines with as many as four motors; for instance on a grinder, three motors are generally used, one each for the wheel drive, the work drive and the table drive. Machines fitted in this manner are entirely portable and can be rearranged to suit changes in the work going through the shop, or can be readily moved to one side and stored. The motors are mounted over the machines to avoid oil and sweepings. We use short belt drives, and spring-controlled idlers to take up the slack on the loose side of the belt; the idler being tensioned by an adjustable spring and fitted with a lock-out trigger, so it may be locked out when the belts are to be shifted, as on cone belts. This character of drive makes the shifting of a cone belt almost as easy as a gear shift and seems to treble its ability to pull a load, keeping the belt in good condition almost indefinitely without cutting to take up the slack. For idlers, we use wooden blocks of carefully dried gum wood, that run loose on hollow-ground spindles, lubricated by compression grease cups.

The current in our shops is 220 volts (for lighting 110 volts) 3-phase, 60 cycle, a.c., used on practically all motors that do not require a variable-speed drive. For variable-speed work, we convert the 60 cycle a.c. power to 110 volts d.c. power by means of rotary converters. Where the d.c. variable-speed motors do not have sufficient range of speed by field control, the armature is given two different voltages, by means of a throw-over switch. Direct-current motors are all compound wound and up to 7½ hp. in size are self-starting without rheostats. Our shop power is very flexible, permitting the rearrangement of our machine tools at any time.

It is our policy to keep all machine tools at a high state of efficiency and keep all adjustments tight. Whenever parts become dented or injured they are immediately repaired or refinished. All chucks are ground true and all tables adjusted for accuracy whenever necessary.



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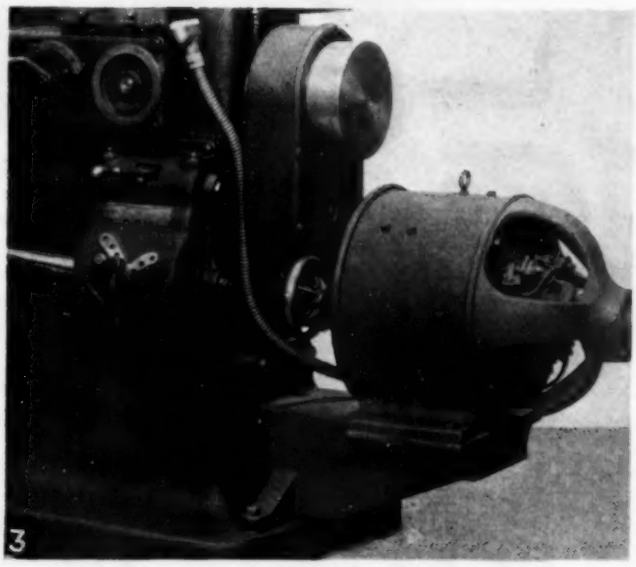


3

Modern Methods of Mounting Motors

Fig. 1—Cincinnati shaper—chain drive in oil splash

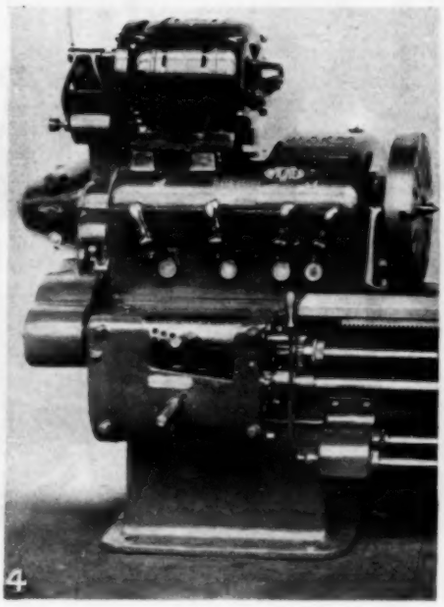
Fig. 2—Wilmarth & Morman 2-motor grinder

Fig. 3—Le Blond milling machine

Fig. 4—Wickes Brothers lathe

Fig. 5—Cleveland multiple-spindle automatic

Fig. 6—Gridley multiple-spindle automatic



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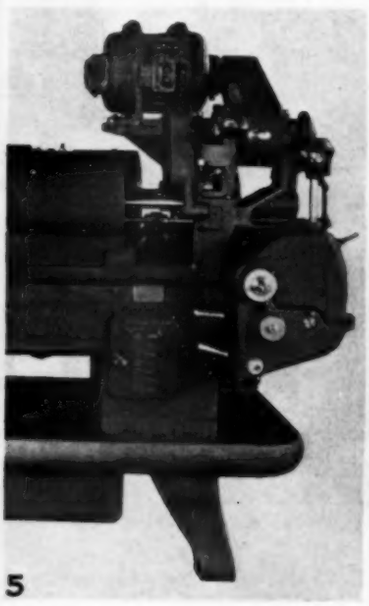

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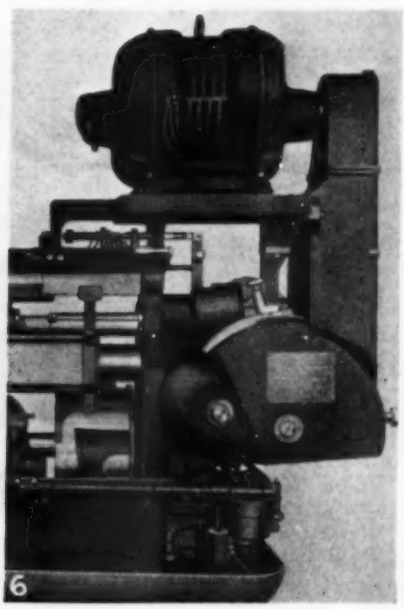

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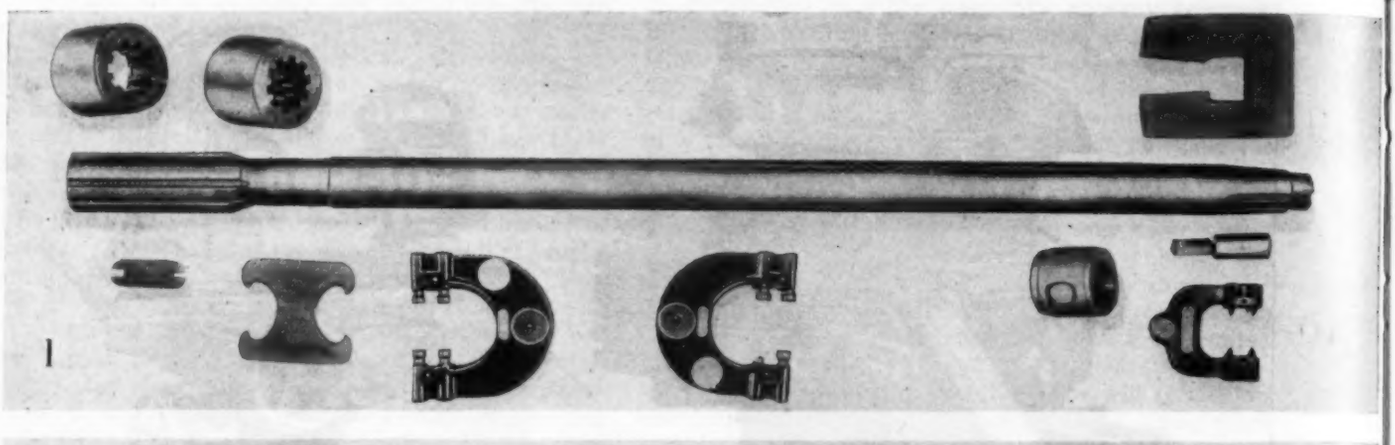

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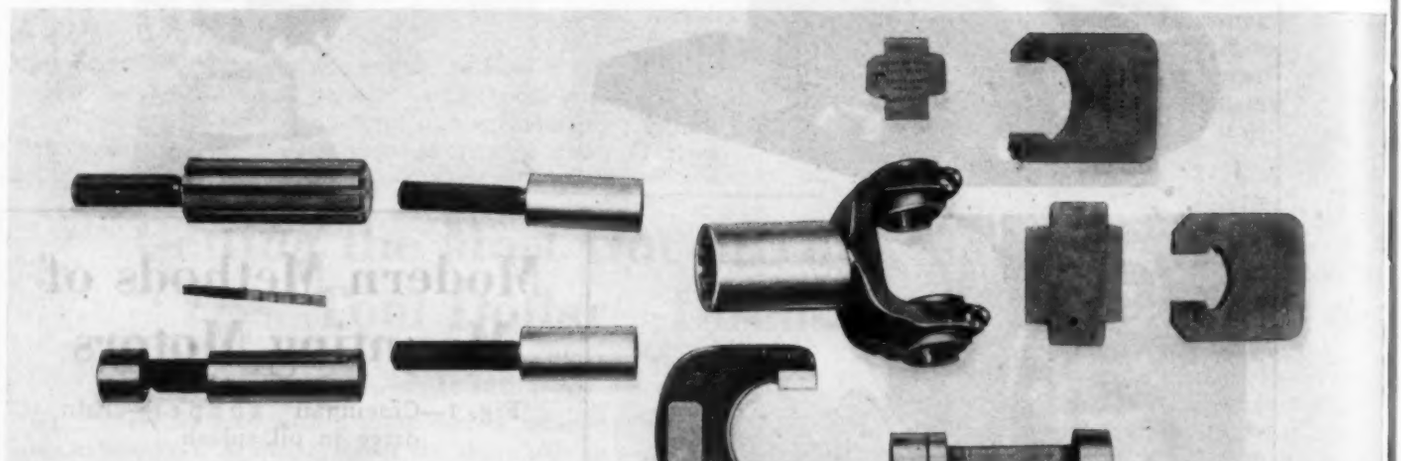

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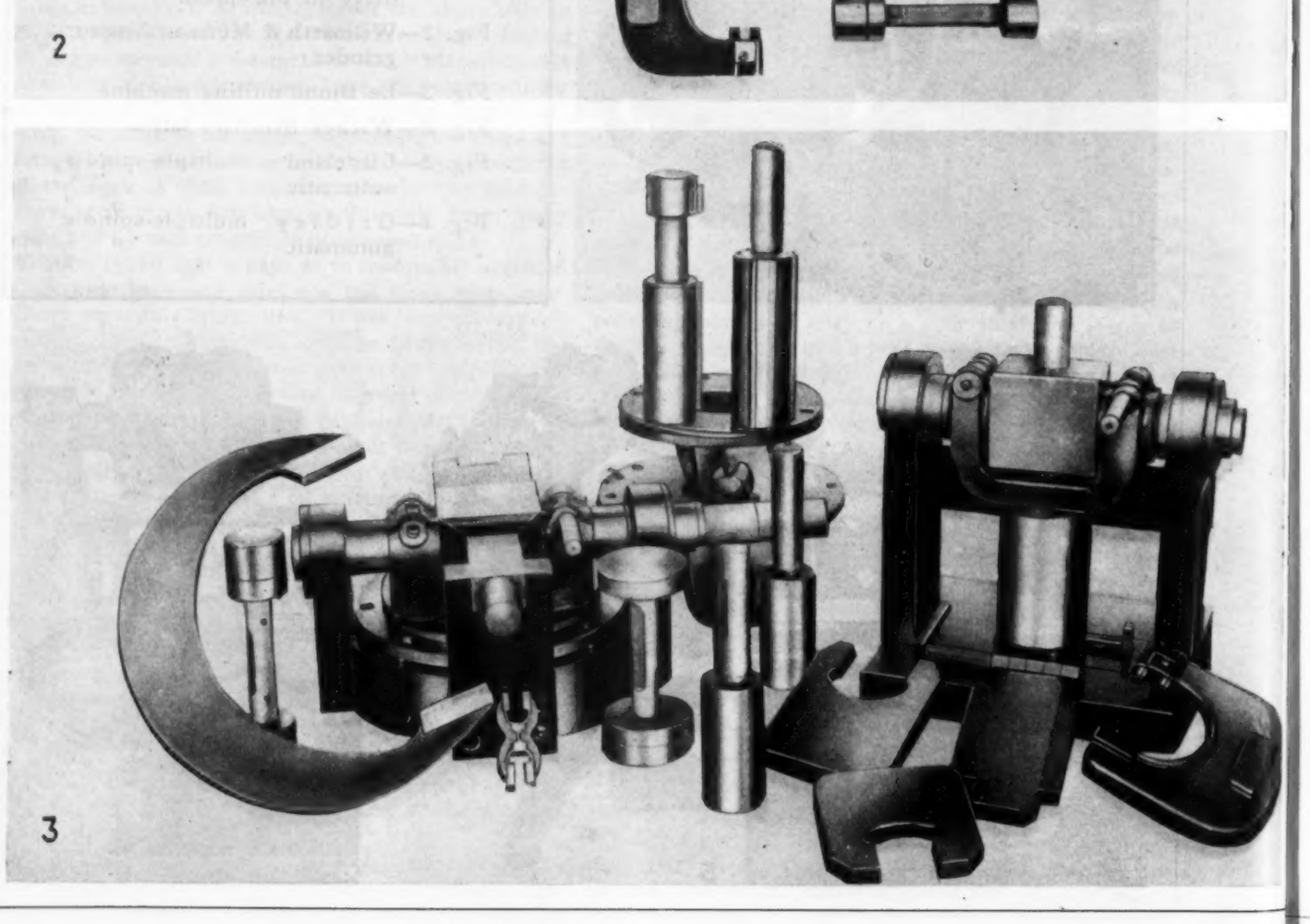
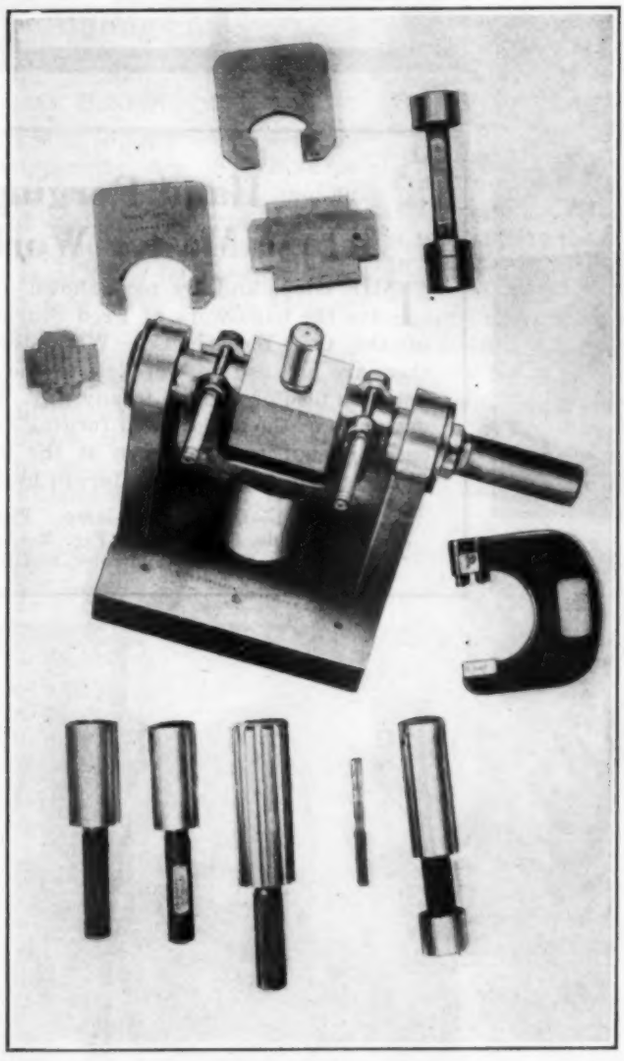


3

Inspection Gages for Truck Universals

The gaging of component parts before assembly plays a very important part in the automobile industry. And the inspection of the large number of parts that go to make up a motor-driven vehicle require gages almost without number. The illustrations show gages used on the G.M.C. truck parts at the plant in Pontiac, Michigan.

Limit gages are largely used, as will be seen from the accompanying illustrations. Fig. 1 shows the gages for the propeller shaft. The splines are tested both at top and bottom, and there is a separate gage for the width. "Go" and "no go" ring gages also test the splined end as a whole.



Another limit snap-gage tests the straight, central portion of the shaft, while the tapered end has both a contour, or sight gage and a taper ring-gage as well as a gage for the key slot and a "go" and "no go" gage for the thread.

In Fig. 2 are the gages for the yoke that goes on the splined end of the propeller shaft. The position of the gages with reference to the shaft, makes their uses almost self evident. It will be noted that the splines are tested singly by one gage and also as a whole, by another.

The gages for the yokes that go on each end of the propeller shaft are shown in Fig. 3. Here again the gages are grouped so far as possible in accordance with the points on which they are used. Two of the bolted flanges are shown in the central background with the single and full spline gages standing on the upper one. The gaging fixtures test the squareness and alignment of the holes. Limit gages are used in nearly all cases.

The gages for one of the units are shown in Fig. 4, the fixture with a yoke in place being in the center. The central block gages the position of the splined holes with relation to the ears of the yoke and also the squareness of the holes in the ears with the hole in the shank, or body of the yoke. The other gages are self explanatory.

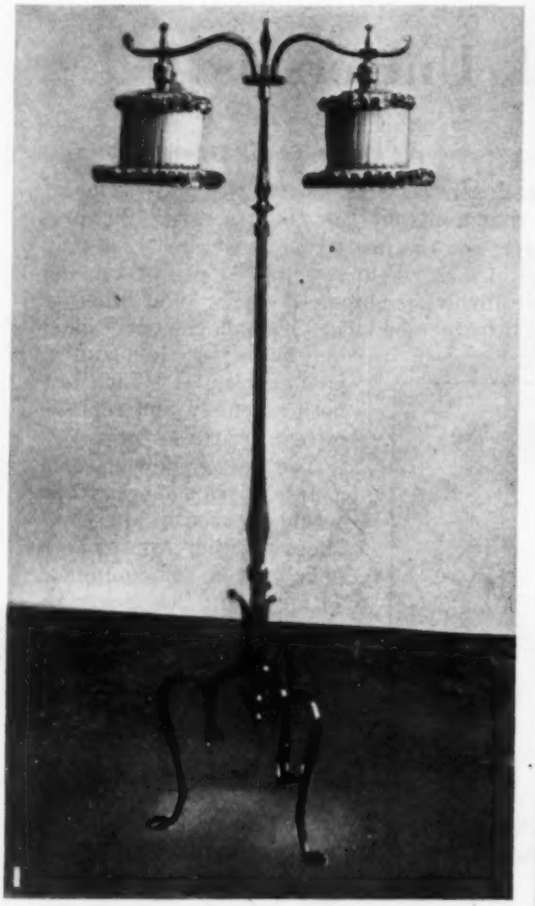
A careful study of the gages shown will show some of the problems that confront the manufacturer, the production manager, and the inspection department, not only in the building of motor vehicles, but the manufacturing of any machine involving numerous parts. For whether the rate of manufacture be large or small, the parts must be more or less interchangeable to facilitate both assembly and replacement of parts.

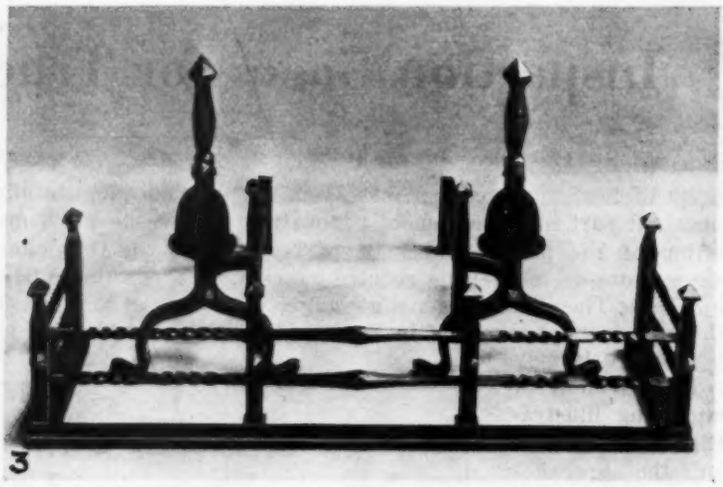
The gages shown are, of course, more elaborate than would be used in any small shop, yet they are a necessary part of the equipment of any plant that manufactures motor vehicles or a similar product in the face of present day competition. Even such a comparatively small part as a universal joint, with only five pieces, excluding the bolts and nuts, must have many gages for each part in order that the parts may not only go together but fit with the desired allowance between them to secure proper functioning and permit sufficient lubrication to insure long life.

Alignment is as important as size when it comes to the proper functioning of parts, hence the necessity for gages that test the relation of holes to each other, as well as for size. And when we use splines to transmit torque as well as to allow end movement at the same time, the gaging problem becomes one requiring experience and skill in designing. This is shown by the use of the single tooth gage to test the proper shape of each spline, and used in combination with the full spline gage to test the relation of the splines to each other, as both shape and spacing have their effect on the proper mating of the universal joint and the propellor shaft.

The number of gages shown indicate that the inspection department fully realize the different factors that enter into proper working of these parts. Only the desire to produce strictly interchangeable work, within commercial limits, would have warranted such an expense.

Photographs by courtesy of the General Motors Truck Co., Pontiac, Mich.

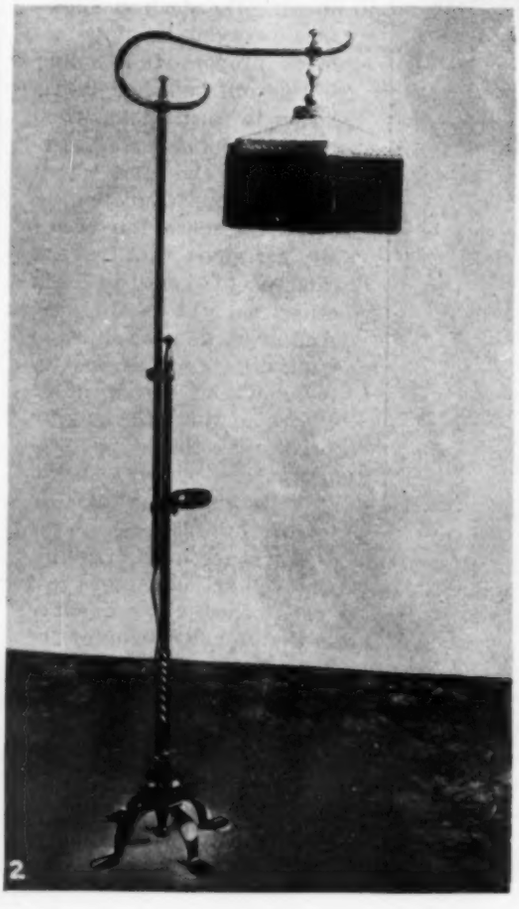


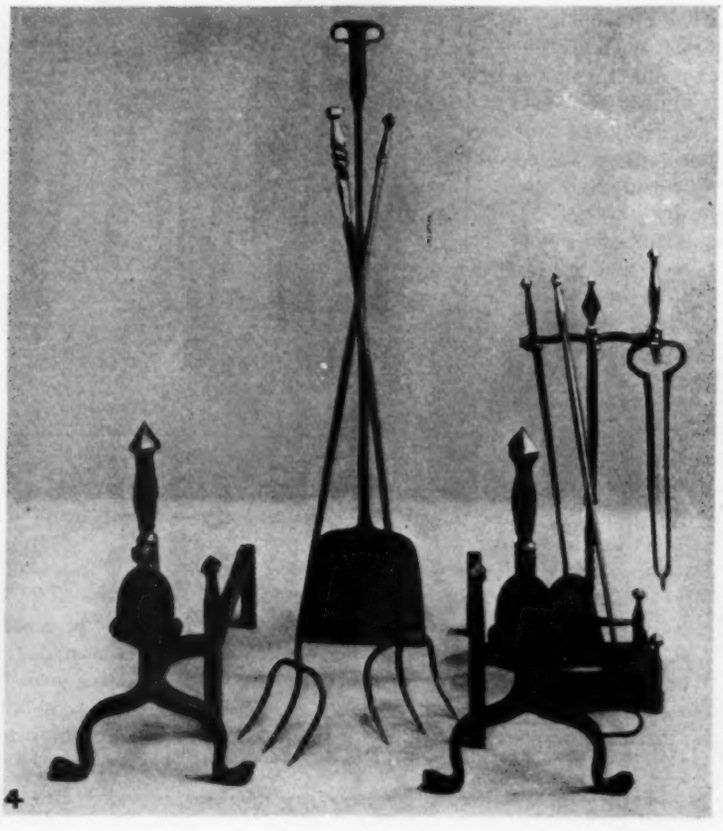


Hand Forgings by a Master Workman

THE lamps and fire tools shown in the illustrations are the handiwork of Fred Searles, superintendent of the Coe Wrench Co., Worcester, Mass. All of them are just as they were left by the hammer and have not been filed or dressed in any way. They are beautiful examples of the art of hand forging and could be duplicated by but few workmen at the present time. We illustrated in 1887 a goblet forged by Mr. Searles.

Fig. 1—Double floor-lamp. Fig. 2—Single, adjustable floor-lamp. Fig. 3—Andirons and fire rail. Fig. 4—Andirons and fire tools.





Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Device to Keep Milling Cutters Clear of Chips

BY WILLIAM DENTON

Some of the cross-rails that support the type-action hanger of the Noiseless typewriter are of such shape that they can be produced most profitably by milling them from a square bar of steel, and since the sectional area of the finished rail is but about one-fourth that of the bar from which it is milled, it follows that there are some relatively heavy cuts taken by the gang of formed cutters that do the work.

Speeds and feeds are pushed to the limit, and a great deal of trouble had been experienced by reason of the chips getting under the cutters, dulling the teeth, causing them to leave the surface of the work in a very rough condition, sometimes loosening the work in the holding fixture and not infrequently breaking the cutters.

The work is done upon Gooley & Edlund milling machines, and in Figs. 1 and 2 may be seen a device that is effective in keeping the cutters clear of chips. Channel irons, cold rolled shapes and standard machine screws are the principal materials of its construction. A couple of bicycle chains and two pairs of sprockets are the only special parts required.

The device is attached to the milling machine by the brace *A*, which serves but to steady the upright member *B*, the latter being made of two channel irons. The horizontal member *C*, which carries at the end nearest the cutters two small sprockets over which the chains run, swivels about the driving shaft in the upright member so that it may be swung slightly beyond a vertical position, where it rests against the yoke *D*. When it is down in working position, as shown in the illustrations, the weight of the horizontal part is borne by the two curved arms *E* which rest upon the top of the milling machine frame.

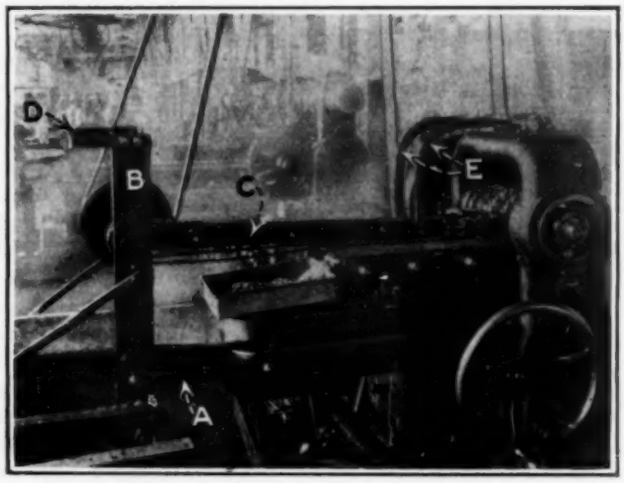


Fig. 1—Device for clearing away chips

On the drive shaft are keyed the two larger sprockets. From them the chains run to the small sprockets.

The lateral distance between the chains is slightly more than the combined length of the gang of cutters; in this case about 4 in. Equidistantly spaced along the length of the chains are four or five rectangular blocks of soft rubber, riveted to both chains. The rubbers are about ¾ in. thick by 1½ in. wide and long enough to span the distance between the chains and overlap them slightly.

In operation, the member *C* is swung down into the position shown in the illustrations, and the sag of the chain allows the rubber wipers to rest directly upon the surface of the work. As the rubbers pass over the sprockets they just clear the cutters, and the speed of the device is so regulated that a rubber is "plopped" down upon the work about every half-second and drawn over its length, pulling the chips into a pan at the end of the fixture.

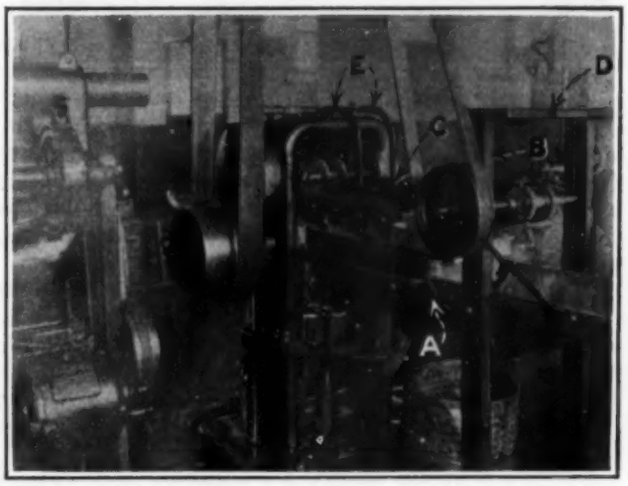


Fig. 2—The device as seen from the rear of the machine

Four jets of cutting compound play upon the cutters from behind, serving to wash the chips away from the immediate vicinity of the point of contact between work and cutters, and since the chips are already impelled in that direction by the action of the cutters, they cannot get back to clog the teeth. The rubber wipers haul them away as fast as they are formed and thus prevent them from piling up.

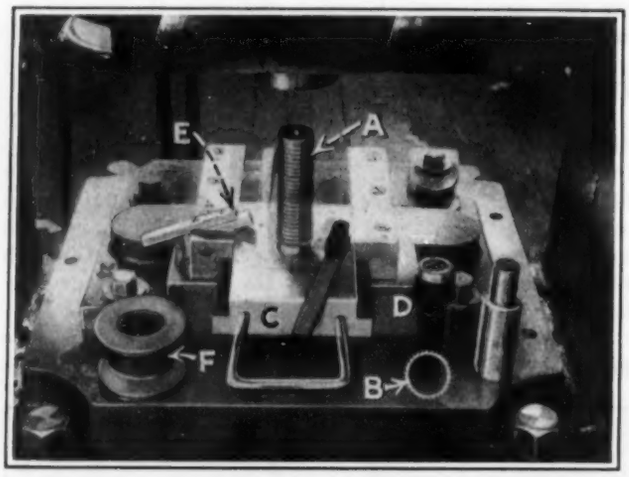
IDEAS FROM PRACTICAL MEN

Broaching Operations in a Press

BY WILLIAM DENTON

The line space ratchet of the Noiseless typewriter is an annular ring of steel having 30 ratchet teeth cut on its periphery by the usual process of milling, while on the inner circumference there are 59 teeth, which, because of the impracticability of milling them, are broached. The work is done in a power press with the tools and accessories as shown in the accompanying illustration.

The working length of the broach *A* is made equal to twice the length of stroke of the press. The number



Broaching in a press

of cutting edges and the consequent draft of each are factors of this length and of the thickness of the piece to be broached, and would have to be calculated anew for any other job; therefore it is not necessary to state them here.

The pitch of the cutting edges is such that after the work is started there are always two edges in the work-piece. The land of the last cutting edge is made wider than the thickness of the work-piece and is without draft, so that it acts as a swage to leave the surface of the teeth smooth and all pieces to size. Part *B* is one of the ratchets.

The shank of the broach fits smoothly and without shake into a bushing of hardened steel in the center of the slide *C*, which is gibbed to the bolster *D* and provided with stops both forward and back. The tool in the press gate is a smoothly-faced, headed bushing having a bore just large enough to clear the broach. The back-stop of slide *C* locates the broach centrally with this bushing and the spring latch *E* locks the slide in this position.

To broach a piece of work, the slide *C* is pulled forward as shown in the illustration, in which position the broach is clear of the press gate and may be lifted out of its holding bushing for the purpose of cleaning and oiling it. A ratchet is set over the smooth pilot of the broach, the slide pushed back to its stop and the press allowed to make one revolution, which pushes the work about half-way down the broach. The slide is again drawn forward, the metal spool *F* set over the broach—where it rests upon the partly broached piece of work—the slide returned to its stop and the press again tripped. This movement completes the broaching and leaves the work resting on the surface of the slide.

As each piece is finished, the slide is drawn forward and the broach lifted from its holding bushing to release the work and to clean the broach. The operator must be very careful to brush out all of the fine chips that cling to the serrations of the broach, else the next piece of work will be rough and uneven.

An Extremely Rigid Tool Set-Up

BY I. F. YEOMAN

The illustrations show a very rigid tool set-up, designed for machining tough, alloy-steel transmission-gear forgings on a No. 7 Foster screw machine.

The gears were gripped by the finished shanks in a collet operated by the automatic-chuck mechanism. The

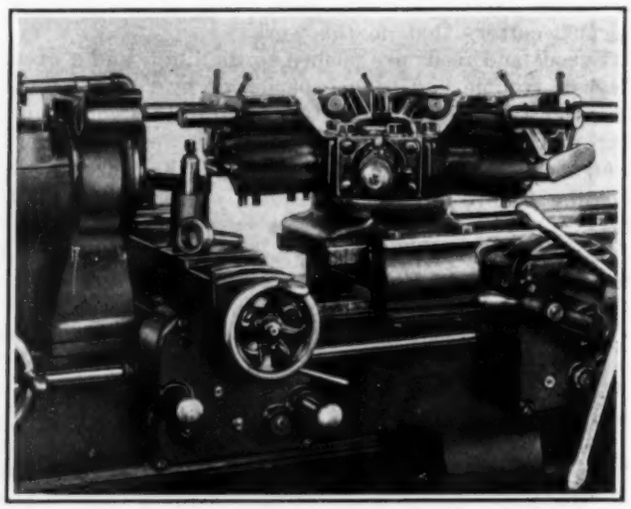


Fig. 1—Rigid tooling set-up

machining operations consisted of turning the outside diameters, facing the ends, and drilling, boring and reaming the taper holes. The average production time was six minutes to complete all operations mentioned. Considering the characteristics of the material the time was very fast. The operations were all simple and perhaps differed in no way from ordinary practice. They are shown in Fig. 1, except that the spiral cutter has been replaced by a taper-boring attachment.

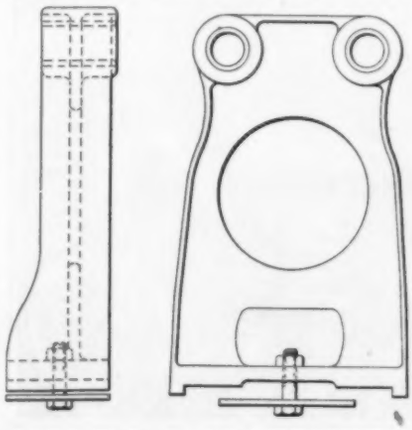


Fig. 2—Details of the steadyrest

IDEAS FROM PRACTICAL MEN

The alloy steel used in the product taxed the cutting tools to the limit of their endurance, necessitating extreme rigidity in their support as being highly essential in the maintenance of low tool regrinding and resetting.

A noteworthy feature of rigidity embodied in the general design, is the use of two overhead pilot bars in the back-turning head mounted on the turret, and the steadyrest type of bracket supporting the pilot

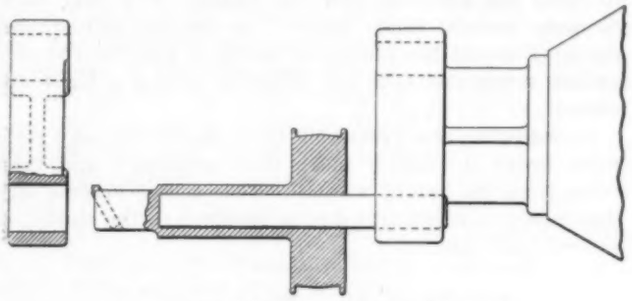


Fig. 3—How the holes were bored

bushings. The major portion of the torque set up in the turning heads by the cutting action of the tools is intercepted by the two pilot bars much more effectively than if one only were employed. All twisting strain is likewise removed from the turret and slide, thus greatly prolonging the life of the machine, as well as maintaining extreme accuracy of the product.

The steadyrest type of bracket for holding the pilot bushings, Fig. 2, is clamped to the lathe ways in the same manner as on an engine lathe.

In order to secure alignment of the two pilot bushings with the bars, the turning heads were first completed and mounted on the turret as shown in Fig. 3, each having only one pilot bar in place. The bracket after being planed and rough drilled was clamped over the ways—a good fit to the ways is essential. The final sizing of the holes was completed with an auxiliary boring tool, slipped over the pilot bar and driven by an overhead countershaft or small motor. The tool was fed through the bracket by the power feed to the turret, with the machine running. After boring the first hole, the second bar was inserted and the second hole sized for the pilot bushing.

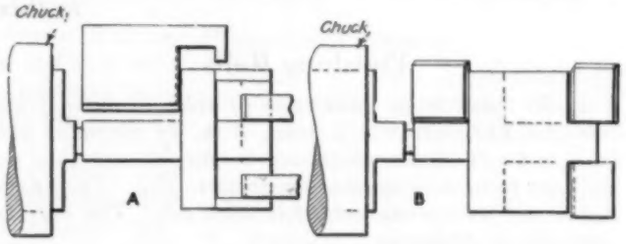
When numerous overhead-piloted tools are designed, standardization of the diameters of the pilot bars would permit the extensive use of a tool like that shown in Fig. 3, and by eliminating an expensive boring-mill operation, would greatly lessen the manufacturing cost of the tooling equipment.

More Work and Fewer Chips—Discussion

BY A. SILVESTER

The method of making the stud and sleeve shown by William Denton in an article under the title given above, on page 171, Vol. 62, of the *American Machinist*, is a good example of efficient planning, but to say that the sleeve costs nothing is wrong. If the stud alone was required it would be drop-forged, thus effecting a saving both in time and in material.

Even if, for some reason, it was necessary or desirable to make it on the automatic from bar stock, the stud would be presented with the longer shoulder outward and the tools fed axially to the work. Obviously



Two methods of tooling

this would be a more rigid set-up and would permit faster speeds and feeds than when the trepanning tools were used. Also there would be but one cutting-off operation where there are now two.

My sketch shows how the job would be tooled up. At *A* is the set-up as described by Mr. Denton and at *B* with the stud turned around and the tools feeding from the end.

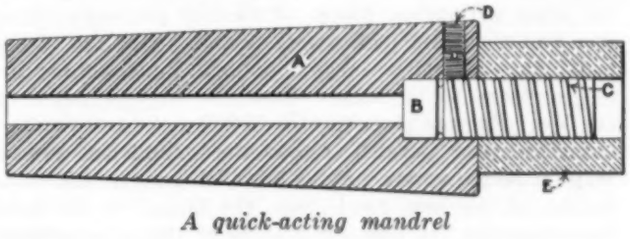
A Quick-Acting Mandrel

BY EDWARD J. GRIEF

The illustration shows a mandrel made for turning the outsides of bushings. The tapered portion *A* is made to fit the taper of the lathe spindle and is provided with the inserted plug *B*, having grooves cut therein, slightly deeper than the diameter of the coils of the spring *C*, but of the same lead.

The spring is wound slightly larger than the plug and is securely held at the inner end by the setscrew *D*. At *E* is the bushing to be turned.

In operation, the bushing is gripped in the hand and pushed over the plug and spring and is turned in the



A quick-acting mandrel

same direction as the spindle of the lathe revolves. This tends to wind the spring tighter and force the coils into the grooves, allowing the bushing to be readily placed. As soon as cutting takes place, the friction between the bushing and the spring causes the latter to unwind slightly and grip the bushing. The heavier the cut, the tighter the bushing will be held.

In removing the bushing from the mandrel, it is necessary only to stop the lathe, turn the bushing in the direction in which the spindle revolves and pull it off.

On first thought it might appear that the gripping power of the spring would be negligable, but I have found it to be equal to the demand.

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Finishing Rolls

Q. We have large quantities of rolls to make from tubing. They are 24 in. long, 5 in. in diameter and have to be finished smooth and bright, though they do not have to be held to close limits as to size. They have light, cast-iron heads welded in each end. The bore in the heads is 1½ inches.

We are at present turning the rolls in a lathe and grinding them after turning. After grinding, they are returned to the lathe and polished with abrasive cloth.

The production is two per hour and we want to increase it five or six times. Can you tell us of a more efficient and cheaper method?

A. Presumably the heads are welded in the rolls before any machine work is done on them. If this is the case, you can cut out the lathe work and grind them in two operations. First, rough them out in a cylindrical grinder so as to true them with the holes in the heads. Second, finish in a centerless grinder. The latter operation is a very rapid one.

If the quantity of rolls is sufficient, you could have the tubing drawn to size, in which case no machine work, other than polishing, would be necessary.

Testing Alignment of a Planer

Q. I am operating a planer in which the vertical travel of the side heads is not square with the cross-rail. How can I find which is out of alignment and how can I make the proper adjustment?

A. In testing the squareness of the side heads and cross-rail of a planer, we should proceed as follows: Lay two truly cylindrical pieces of steel of the same diameter and about six inches long in the V-s of the planer bed. They should be large enough in diameter for the top surfaces to be higher than the highest parts of the V-s. Put one piece in each V below the cross-rail.

Lay a true parallel across the cylindrical pieces. With a large square on the parallel and an indicator in one of the side heads, test the travel of the head for squareness at top and bottom of the square-blade. If the head does not travel squarely, shim up the parallel at one end and test again. This test may have to be repeated several times before you get satisfactory results.

When you get the parallel square with the head on one side, test the head on the other side in the same way, but don't disturb the alignment of the parallel. The second head should travel squarely with parallel. If it does not, the job of aligning the housing is one for a machine-tool builder. In fact we would not be able to tell you how to do it, without seeing the planer.

If both heads travel squarely with the parallel, test the cross-rail at each end by a surface gage or indicator placed on the parallel.

If the cross-rail shows out in this test, disconnect the pinion from the bevel gear of the elevating screw on the low side of the cross-rail, and turn the screw to raise the low side and test again. You may have to make several trials before you get the adjustment right. Connect the pinion to the bevel gear on the elevating screw and true the table by taking a light cut over it.

In lowering the cross-rail of a planer for any purpose, lower it slightly more than necessary and then raise it to the height wanted. This will overcome any inaccuracy of alignment due to backlash in the elevating screws and nuts.

Grinding Keyways

Q. I have a lot of hardened shafts 1½ in. in diameter, in each of which is a ½-in. keyway to be finished by grinding. How can I tell if I am keeping the keyway central, as the grinding progresses?

A. You can test the centralness of the keyway by means of a dial indicator mounted on a base and arranged with a stop to contact with the side of the shaft. With the stop in contact with one side of the shaft and the indicator button against the opposite side of the keyway a certain reading of the gage will be found for this dimension.

Moving the gage to the opposite side of the shaft and proceeding as before, the gage should read the same, providing the keyway is central.

By taking readings from both sides of the shaft, you will know how to grind the keyway so as to keep it central.

Babbitting Connecting Rods

Q. What information can you give us as to the best method of babbitting connecting rods by both pressure and centrifugal methods?

A. You will find descriptions of several methods of babbitting connecting rods on page 1023, Vol. 52; page 829, Vol. 53; page 732, Vol. 56 and page 150, Vol. 59, of the *American Machinist*.

Power and Torque—a Correction

On page 706, Vol. 62, of the *American Machinist* is a question headed Worm Gearing.

The actual power (force × distance per unit of time) which is available on the driven side of the 5½ to 1 gearing, will be less than the 20-hp. input by the frictional power losses in the mechanism.

The torque, however, neglecting friction, will be as 5½ to 1 since the gearing acts as a lever of the given ratio. Torque is here defined as mechanical advantage applied to rotary motion.

Technical Abstracts

Material Handling

Maxwell C. Maxwell, general superintendent, the Yale & Towne Manufacturing Co., describes the fundamentals of trucking practice, which are, first, that the equipment should be adapted to the work that it must do, and second, the day's work of each truck should be scheduled. How the plan has been accomplished in this organization is shown in the article.

The Yale & Towne plant consists of 68 buildings that have gradually grown from the one small building started at Stamford, Conn., in 1870. Man-power trucks were used until a few years ago which required the full time of about 75 men, while the speed and service were poor. These trucks have been done away with and now the company relies on electric trucks and trailers entirely, bringing about greater speed and less fatigue for the men and a smaller trucking payroll.

In making a study of the problems, the best routes for the trucks to take, the kind of trucks best adapted to the materials, and the conditions under which they would work, were considered. The result of the study led to the equipping of the plant with electric trucks of the following types: large platform, drop frame or low platform, elevating platform, and a small three wheel, low platform truck. For special uses throughout the plant some of these trucks are equipped with quickly detachable cranes, dump bodies, or lifting forks. Trucks should be scheduled and for the reason that they should move over proper concrete highways and, by proper scheduling, a minimum number of highways are needed thus saving time and space.

An interesting comment is that it formerly took six men to carry cores from the core room to the iron foundry. The cores were sent down in an elevator to the brass foundry where two filled trays were put on a hand truck and taken to the iron foundry. Two men in the iron foundry put in their time distributing the cores to the molders. Trailers with special spring bodies, each designed to carry ten trays of cores, were put in operation and two trips each day taking 15 minutes, have been sufficient to keep the foundry supplied.

Other instances are given and there is a typical schedule covering the operations from 7 a.m. to 5 p.m. for a number of trucks.—*Factory*, April, p. 594.

Distortion of Heat-Treating Steel

Stanley A. Richardson, assistant professor of metallurgy, the Lewis Institute, Chicago, states some of the problems in heat-treating steel and summarizes the points that steel may warp or crack because of uneven heating, slag inclusions and other segregation, deep tool marks and sharp corners, unrelieved forging, machining, or quenching stresses, uneven cooling due to mass, irregular cross-section or improper quenching and uneven tempering.

The mechanism of warping and cracking in the heat-treatment of steel appears to be two-fold, first, compression or distortion of hot sections by adjoining cooler sections, and second, the presence in close proximity in the steel of metallographic constitutents having markedly different volumes or densities. Pieces to be heated should not be placed on the cold floor of the furnace, should not be in contact, or so piled that the hot gas does not have a chance to circulate around them uniformly.

The quenching of a piece of steel should be done rapidly and with due regard for its mass and cross-section. This should be immersed in a direction parallel to the longest axis, with the larger end down. If hollow, the piece should be quenched so that the liquid has free circulation through the cavity, permitting the ready escape of any vapor formed. When only part of a piece is quenched it should be so agitated that there is no sharp line of demarcation between the quenched and unquenched portions.—*Fuels and Furnaces*, April, p. 359.

Precision Lapping

William E. Hoke states that lapping as applied in precision tool and gage making is a direct inheritance from the lapidary, who has long employed this method of cutting and polishing precious stones by means of diamond dust charged or embedded in a copper disk.

One method used is to have two surfaces of equal hardness, between which non-charging abrasives are utilized. A typical use of the non-charging type of abrasives is in wearing-in a lathe spindle into its bearings where both components are of hardened steel. In this operation the use of powdered whetstone with oil causes the abrasive to wear equally on the two parts, with the result that one part quickly wears into the other and produces an accurate fit.

Full consideration should be given to charging abrasives. One of these is commercially known as "diamond dust." This dust possesses wonderful properties for the treatment of hardened steel. It is usually used with either a cast iron, machine steel or copper lap. It is the best abrasive for work in which it is desired to obtain accuracy of surface and great brilliance, rather than a surface that is highly polished and reflecting.

One point Mr. Hoke brings up is that in actual practice it is necessary to grind and lap more than three pieces of metal to obtain an interchangeable fit. The principal difficulty in effecting accurate lapping of a surface lies in the film of lubricant, abrasive, and air between the two opposing surfaces. The remedy for this condition is found in scoring the laps and allowing the air film to escape and the oil film to be pushed outside. Dry lapping, he states, is much more accurate than the so-called "wet-lapping" in which a lubricant is used.

Uniform temperature is essential for accuracy. If the work is warmer than the lap the result will be a concave surface, and if the work is colder than the lap, a convex surface will be produced.—*Machinery*, April, p. 593.

American Machinist

Established 1877

KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

Adolphus Otto Backert

THE sad news of the death of Adolphus O. Backert, president of the Penton Publishing Co., reached us in time for a short obituary note to appear in the April 30th issue. His sudden death was a shock to his many friends in the publishing field as well as to the iron and steel industry served by his papers.

Mr. Backert was one of the few business paper publishers to come up through the editorial side. He contributed much to the advancement of technical publishing. For an estimate of his achievements we can do no better than quote the following comment made by one of his associates: "His career was testimony of the opportunity for service open to the technical journalist. Never a producer or merchant of iron and steel products, he so saturated himself with the atmosphere of the business that for years he had been admitted to its inner circles as a valued advisor. He was not technically educated but he learned early in his editorial life the value of study of his specialty and he long since became known as an expert, not only in the business of iron and steel but also in its technology. In foundry practice especially he had for years been one of the leaders. In his later life when his administrative duties as head of a large publishing company made it impossible for him to continue close editorial contact with his field, he still retained the confidence of the industry and improved every occasion to capitalize that confidence in advice and suggestion to his editorial associates."

Rational Standardization Growing

ONE of the hopeful signs of more efficient manufacturing in the future is the way in which manufacturers in different lines are adopting and pushing the new standards in their respective industries. The makers of abrasive wheels, for example, are almost unamimously behind the new and simplified list of wheels recently adopted by their association. This list, which appeared recently in the "American Machinist," greatly reduces the number of shapes and sizes and so lessens the cost of manufacture and the expense of handling for both the maker and the dealer.

Makers of bolts, nuts and screws are adopting the new American (National) Standard both as to sizes and tolerances. A few years should find a much better condition in the commercial bolt field both as to uniformity and quality of product. In this connection it is well to bear in mind the good work done by the National Screw Thread Commission, even though the name (National) has been subordinated in the final naming of the standards. These new standards carry through in a logical manner the factors necessary to secure good thread fits that were omitted in the Sellers or U. S. tables.

Users of milling cutters and similar tools are also tending to get away from odd, if not special sizes, and to adopt a rational policy in designing methods and fixtures. The importance of this can be seen when we stop to consider the large sums tied up in supplies in some of the large manufacturing plants. In one well known plant the reserve investment in such small tools as taps, reamers and milling cutters averages about half a million dollars. This does not include the total number of tools used in the plant but the reserve supply held in the tool stores. If the cost of this supply can be reduced even ten per cent by eliminating unnecessary sizes, and this is easily possible, it leaves $50,000 available for more useful purposes.

Rational standardization and simplification is not a fad. It is a real factor in economical production.

Room for Standardization of Method

ATTENDING a recent meeting of the Society of Automotive Engineers, in which there were presented five papers dealing with the manufacture of the connecting rod, one could not help be impressed with the thought that here was a wonderful opportunity for the furtherance of the late Frank Gilbreth's statement that there is "One Best Way to do Work."

The connecting rod is one of the most nearly standardized parts in the automobile engine. Its variables such as length between centers and width do not affect machining operations. Due to the large number produced, sometimes four, sometimes six and sometimes eight to each engine, one would think there would be a measure of standardization in the manufacturing methods, but these five papers showed five different ways of finishing the rods. One shop believes in drilling one hole at a time, another by multi-spindle machines practically drills all the holes simultaneously. One manufacturer coin-presses his rods, another mills the faces. One plant has eighteen operators on as many operations before the final rod is delivered to the assembly floor. Another gets away with half this number.

This is only one instance out of many that might be taken. The automotive industry is, we believe, the most progressive of all industries from the production standpoint but there is evidently opportunity for further thought and progress.

Shop Equipment News

Hilles & Jones Plate-Bending Machine

The machine illustrated has been brought out by the Hilles & Jones Works of the Consolidated Machine Tool Corporation of America, Rochester, N. Y. The outstanding feature is that it will roll plates true to form without the flat spot, usually left on the edge of the work. Tank and boiler parts are rolled to their ends so that the edges can be welded if desired.

The capacity is ⅜-in. soft plates, 14 ft. wide, or a corresponding duty. The upper roll is 13½ in. in diameter, having a vertical adjustment for pinching the plate and a horizontal adjustment so that it may be brought over the center of either of the lower rolls. By this arrangement, the plates are bent to the radius desired.

The top roll is provided with a forged extension for counter-balancing, when the back housing is dropped down for the removal of circular-rolled work. The vertical adjustment of the top roll, controlled by positive clutches, permits both ends to be raised or lowered together or independently to a distance of 4 in., while the horizontal adjustment is 7¼ in. each side of center. Individual motors operate these two adjustments, offering a flexible control for any movement required.

The lower rolls are 10½ in. in diameter, have a center distance of 14½ in. and are also driven by a separate motor. A heavy center support is provided for these rolls.

The yoke is lowered by an air-operated cylinder, so that finished plates are removed more rapidly and can be handled through the machine in less time than by the use of a crane. All of the adjustments are made by means of worm and worm-wheel drives that are totally inclosed in oil. All gears, used throughout the machine, are cut from the solid.

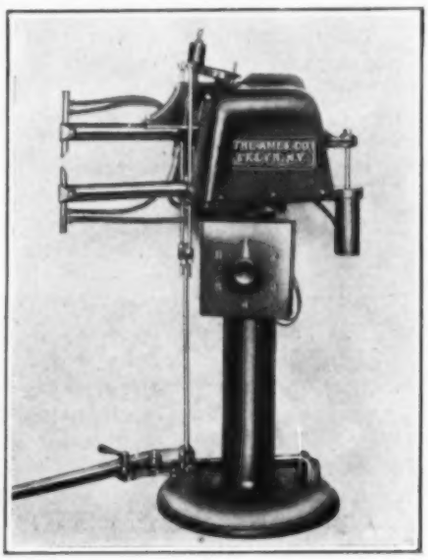
A plate-travel speed of 15 ft. per min. is possible. The weight of the machine, less the electrical equipment, is 72,000 pounds.

Ames Spot-Welding Machine No. 18

On taking over the business of the H. J. Ness Manufacturing Co., that made the line of spot-welding machines previously described on page 345, Vol. 59, of the *American Machinist*, the Ames Co., 302 Pearl Street, Brooklyn, N. Y., has redesigned the line, added improvements and is offering its machine to the trade. The No. 18, as illustrated, is one of the improved machines which is rated at 11 kva. on 220-volt, 60-cycle current.

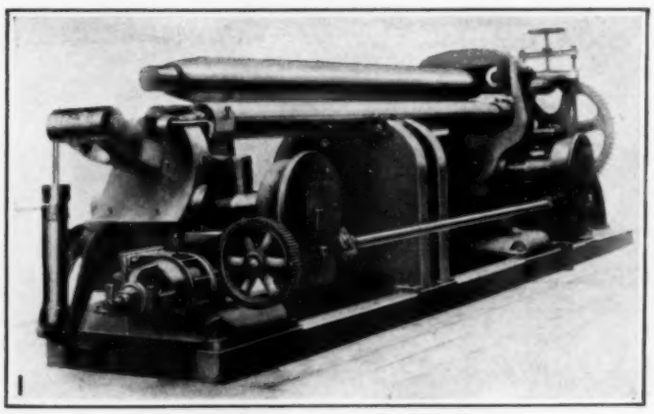
The line covers capacities to weld stock up to a combined ½ in. in thickness in plate form, or bars totaling 1 in. in diameter.

Depressing the foot pedal brings the upper point down to pinch the parts to be welded between it and the lower point before contact is made through the transformer. Further downward motion completes the circuit and makes the weld. Releasing the pedal cuts off the current before the points draw apart to prevent arcing and burning or pitting the parts. The oil switch for opening and closing the welding circuit and the transformer are the two points at which the company has made its improvements over the original design.



Ames Spot-Welding Machine No. 18

Where only direct current is available, the company is prepared to furnish a motor-generator set or a rotary converter to specification. Special length arms and machines to operate on other than the standard 220 volts at 60 cycles may also be specified, as well as special machines.



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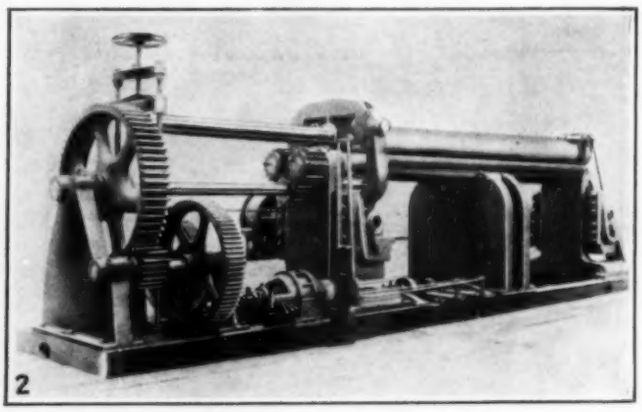

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Fig. 1—Hilles & Jones Plate-Bending Machine. Fig. 2—Reverse side of the machine

SHOP EQUIPMENT NEWS

Loewe Precision Lathe

A lathe built by Ludwig Loewe & Co., A. G. Berlin, and marketed by Stoehr & Sons, Inc., American agents, 200 Fifth Ave., New York, N. Y., has included in its design a number of features intended to improve its usefulness. The carriage and head end in which the improvements are made are illustrated in Fig. 1, and in Fig. 2 a phantom view of the carriage is shown to illustrate a length-stop action that is said to be operative within 0.0001 inch.

The toolholder is arranged on the turret principle and carries a number of toolposts *A* into which the tool can be set at any independent angle.

A trip mechanism in the apron is designed to stop motion of the carriage longitudinally at any predetermined point within the close limits named. A spindle *B* has a gib on its end which acts as a support to keep the mechanism in operative position until the stop *C* is brought in contact with the plunger at the end of the carriage, by setting length gages of various dimensions between the two, depending on the position at which certain cuts are to be stopped.

A gear *D* driven from the leadscrew of the lathe meshes with another gear to rotate the worm wheel *E* and the worm *F* so long as the carriage is in motion. When the stop comes in contact, however, with the stop plunger the wormwheel *E* is prevented from rotating further while the worm continues to turn. The result is that the worm threads along the wormwheel and draws its extension away from on top of the supporting spindle gib and allows the worm and wormwheel to fall out of mesh.,

The stop *C* is roughly adjusted by two set screws and is finally set by regulating a micrometer screw which is included to obtain the requisite accuracy.

The other principal feature in the design lies in the feed-gear box. With a limited number of gears, a wide range of feeds can be set with the levers shown. The box is further arranged to allow of changing gears for unusual conditions that may arise. English and metric threads may be set for without any pick-off gear changes.

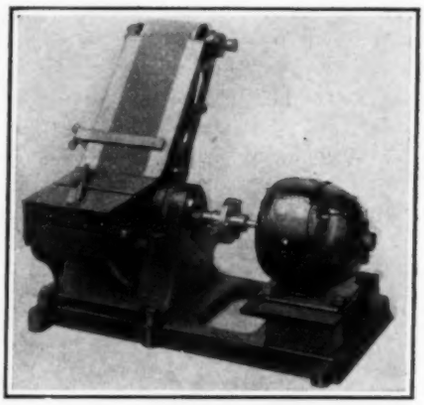
Coats Adjustable Bench Grinder

The belt-type grinder illustrated is being built by the Coats Machine Tool Co., Inc., 110 West 40th St., New York, N. Y. It has been designed for producing a straight-grain finish on small metal parts and castings of iron, steel, brass, gunmetal and aluminum. It may also be used for producing the finish desired on bone, fiber and horn goods, vulcanized rubber, celluloid, wood and similar materials.

Abrasive bands 4 in. in width by 38¾ in. long, for metal and wood grinding, in grits from 000 to 3, are available from stock as well as belts of special leather for polishing with rouge or other fine abrasive powder. Correct tension is maintained in the band by a movable weight.

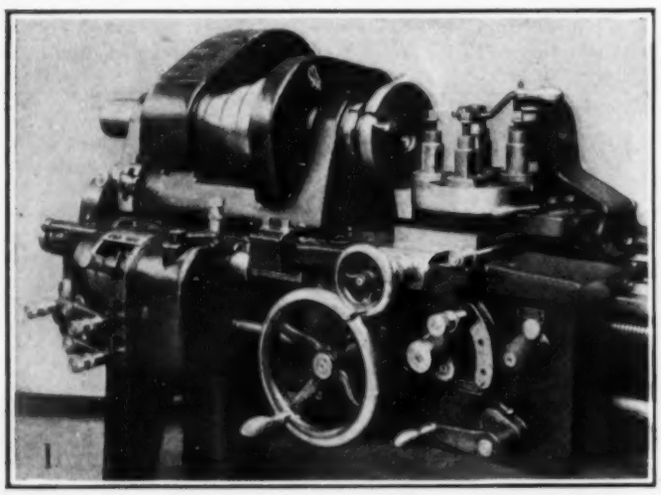
The 12½x6¾-in. grinding table over which the band rides carries a 3-in. diameter drum on its outer end and is set to swivel about the center of the other drum in the frame of the machine. It is held in any desired position between horizontal and vertical, by means of two clamp bolts, a graduated quadrant showing its exact position.

Another 7⅞x6¾-in. table which carries the work for angular grinding



Coats Adjustable Bench Grinder

can be adjusted to match the grinding table for any given work. Both of the tables are arranged for and provided with work-backing stops. The speed of the direct-connected grinding motor, which is furnished in 110 or 220 a.c. or d.c. current, is varied between 500 and 1,200 r.p.m. to suit the work in hand. The machine complete with motor as illustrated weights 110 lb. net. It is grease lubricated.



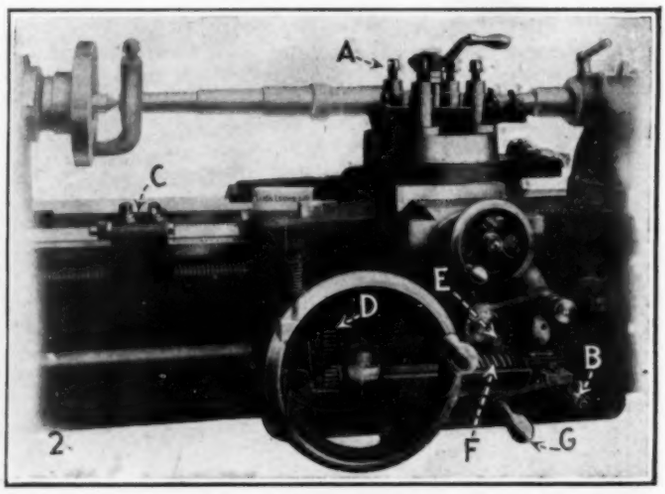


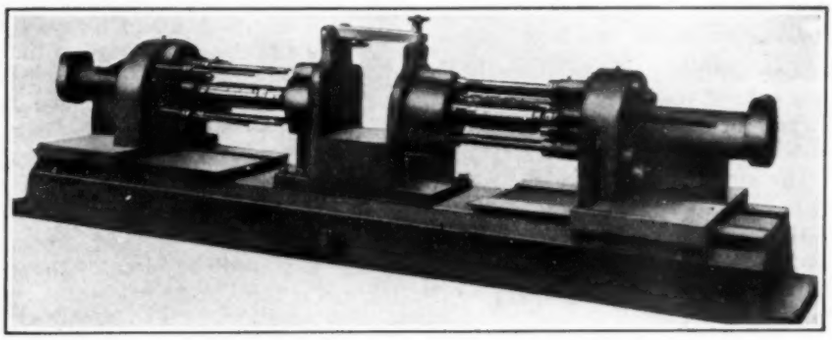
Fig. 1—Loewe Precision Lathe. Fig. 2—A phantom view of the apron

SHOP EQUIPMENT NEWS

Hoefer Transmission-Case Boring Equipment

To provide for the drilling, rough boring, size boring and reaming of transmission cases in one setting, the Hoefer Mfg. Co., Freeport, Ill., has developed the equipment shown.

On the special sub-base, fitted to the standard two-spindle horizontal driller, is carried the jig for locating the work. Four locating blocks and an equalizing clamp hold the transmission case securely.



Hoefer Transmission-Case Boring Equipment

The rough borer, size borer and reamer are located on one bar positioned so that each tool passes through the work before the next one enters.

The auxiliary heads are geared so that proper surface speeds are maintained in proportion to the diameter of the tools being driven, and in the equipment shown the center bar runs at 130 r.p.m. and the smaller spindles at 1,200 r.p.m. These units are made to the usual Hoefer standard practice, with the gearing inclosed in a solid housing.

The heads are brought up to the work by hand and then fed through by the usual power feed. The floor-to-floor time for completion of a transmission case with the equipment is five minutes.

Ex-Cell-O High-Speed Grinding Spindle

An air-turbine-driven grinding spindle that operates at extremely high speeds has been developed by the Ex-Cell-O Tool & Manufacturing Co., 1469 East Grand Blvd., Detroit, Mich. It is being built in two sizes, the smaller of which is illustrated in Fig. 1. The spindle is intended for application on hobs, taps, threads and worms, and for small hole grinding. On the last named work, holes as small as $\frac{3}{32}$ in. in diameter can be ground on a production basis by using a steel-insert, pencil wheel which is made by the company for this purpose. It is said that the method cuts a large portion from the time usually required for the work when lapping is resorted to.

With an applied air pressure of between 80 and 90 lb., the smaller size rotates normally at 65,000 r.p.m., while the larger is rated at 35,000 revolutions per minute.

A throttle valve is provided to control the air admitted and a gage, which is calibrated to revolutions in terms of the air pressure, is included so the speed may be controlled within close limits.

The gages are individually calibrated when the spindles are undergoing test by comparison with a speed-measuring device capable of reading to 100,000 revolutions per minute.

The spindle is shown disassembled in Fig. 2 to give an idea of its construction and of the part dimensions by comparison with the circle representing the size of a silver dollar. The ball bearings are made by the company and are designed as previously described on page 597, Vol. 61 of the *American Machinist*.

The smaller model measures 6 in. in length by $1\frac{1}{8}$ in. in diameter, while corresponding dimensions on the larger are 8 in. and $2\frac{1}{2}$ in. The smaller size is used on holes up to $\frac{1}{4}$ in., and the other extends the range to $\frac{1}{2}$-in. diameters.

The company has also added another extra-heavy-duty type of belt-driven spindle, having a shaft diameter of $1\frac{3}{8}$ in., to its line of belt-driven equipment. It is similar in all respects to the one previously described on page 597, Vol. 61 of the *American Machinist*, and is intended to increase the range for application of the line.

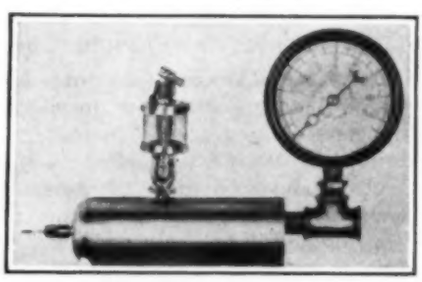


Fig. 1—Ex-Cell-O High-Speed Grinding Spindle

Referring again to the air-driven spindle it should be mentioned that the design is such that the incoming air after passing through the turbine is carried over the bearings for the double purpose of cooling and preventing the entrance of dust.

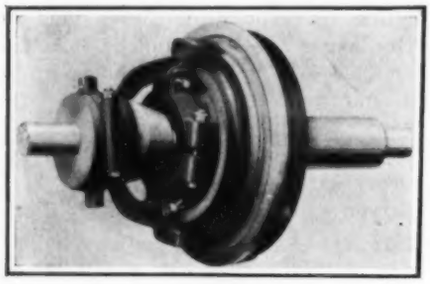
Fig. 2—The complete set of spindle parts

SHOP EQUIPMENT NEWS

Jones Lemley Friction Clutch, Model "F"

The clutch illustrated has been developed by the W. A. Jones Foundry & Machine Co., 4404 West Roosevelt Road, Chicago, Ill., for application to machines and countershafts which require a light or medium-duty friction clutch.

The small number of parts and their accessibility, together with the



Jones Lemley Friction Clutch, Model "F"

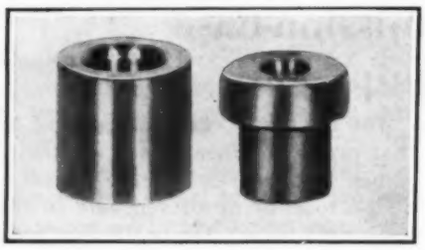
fact that no special tools are required for adjustments or disassembly, have been featured in the new design. Pressure is applied to the friction rings of fiber or asbestos brake-lining material by means of two toggle levers actuated by the cone on which their ends ride.

The model "F" is furnished as a sleeve clutch, as a cut-off coupling, or for bolting to the arms of pulleys, sprockets, gears, sheaves and similar power-transmission units. It is built in various sizes to suit a range of requirements.

Ex-Cell-O Standard Drill-Jig Bushings

The Ex-Cell-O Tool & Manufacturing Co., 1469 East Grand Blvd., Detroit, Mich., has made two additions, as illustrated, to its line of standard bushings previously described on page 751, Vol. 61, of the *American Machinist*.

One, a plain headless design, is carried to stock in all numbers, letters and fractional drill sizes. The steps in the last named series are in sixty-fourths from 1 to 1¼ in., and in thirty-seconds from this point up to 2 in. inclusive. The bushings are available in three lengths and the separate sizes in the entire range of sizes have been grouped into eight



Ex-Cell-O Standard Drill-Jig Bushings

outside diameters to fit holes bored to standard plug gages, with an allowance of 0.020 in. for grinding the bushing.

The other bushing, which is made with a head as illustrated, is similar to the headless design as pertains to the range of sizes and grouped outer diameters, with allowance for fit and choice of lengths.

Both styles are made of high-grade tool steel, are heat-treated to file hardness and are held to tolerances of minus 0.000 to plus 0.0003 in. in the bushing holes.

Whitney Imperial Punch No. 8

A lever-type punch that will operate inside of 90 deg. and on such work as standing seams, stacks and skylights has been added by the Whitney Metal Tool Co., Rockford, Ill., to its other lines of metal-working equipment. The tool is arranged for a positive stripping action, is equipped with roller bearings and is designed to take the company's standard punches and dies. The parts are drop-forged and heat-treated, and all of the wearing parts are hardened.

The capacity of the Imperial No. 8 type is ¼ in. hole in ¼ in. iron. The throat depth is 2¼ in. and there is sufficient reach to punch holes in the center of 4¼ in. It has a ⅜ in. height of gap, is 25 in. overall and weighs 16 pounds.

Brown & Sharpe Cutter-Clearance Gage No. 900

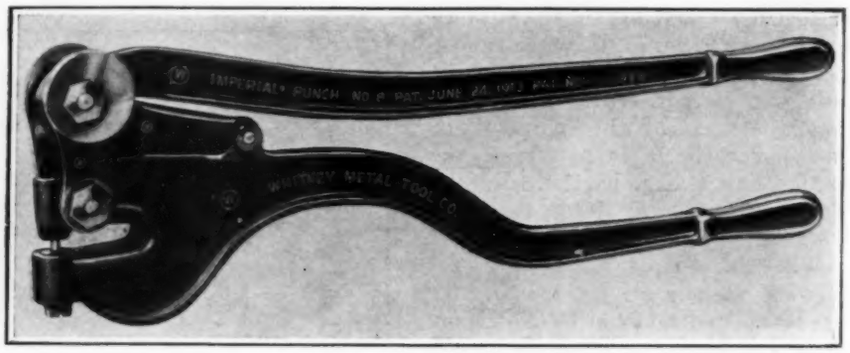
The Brown & Sharpe Manufacturing Co., Providence, R. I., has designed a simple gage to be used in checking the clearance angle on milling cutters after the cutters have been reground. It is arranged for application to either hand of cutter teeth and for end mills of any style. It will measure any cutter from ½ in. to 8 in. in diameter and is not limited by cutter width.

The V-shaped body locates the cutter and a gage blade in correct rela-

Brown & Sharpe Cutter Clearance Gage No. 900

tion to the center line of the cutter to be tested. The blade is shaped on its end to fit the tooth to show whether the angle is correct or not.

All contact surfaces are hardened and ground.

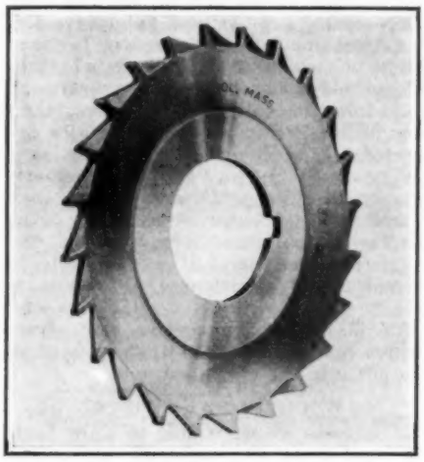


Whitney Imperial Punch No. 8

SHOP EQUIPMENT NEWS

Union Twist Drill Co. Metal Slitting Saw

The slitting saw illustrated has been added by the Union Twist Drill Co., Athol, Mass., to its line of cutting tools. The one shown is 3 in. in diameter by $\frac{1}{8}$ in. in width and has a distinctive feature in that the

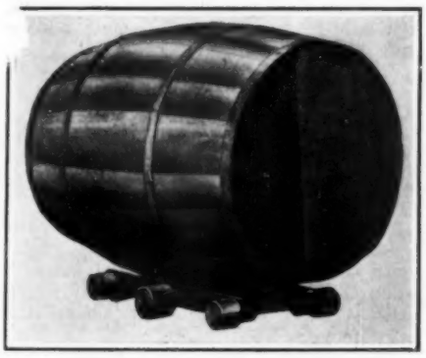


Union Twist Drill Co. Metal Slitting Saw

teeth are designed and ground to cut on their sides as well as on the diameter edge. This feature is said to materially improve the quality of the work performed and to increase the speed of cutting, as well as to prolong the life of the cutter.

Marion Dolly Truck

The Marion Tool Works, Inc., Marion, Ind., has brought out a dolly truck for moving heavy loads, such as crates, barrels, boxes, tote boxes,



Marion Dolly Truck

rolls of paper, and similar loads throughout the plant.

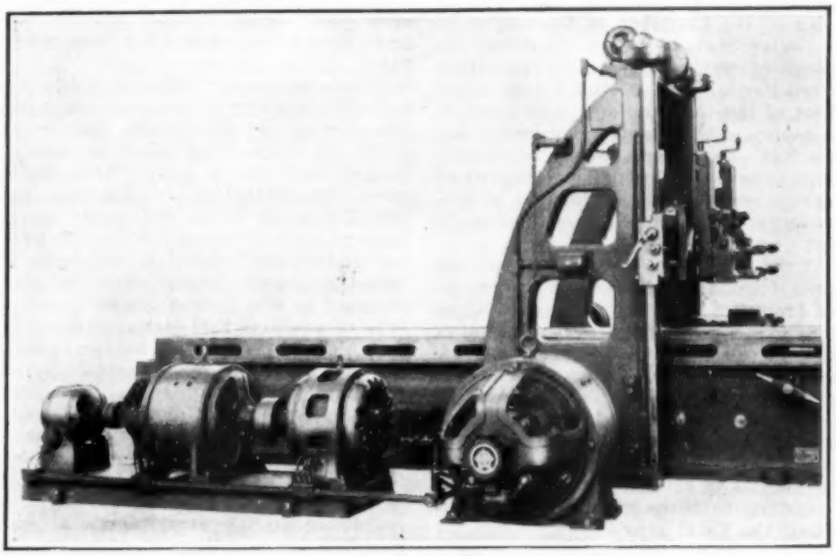
These dollys are light enough to be easily transported wherever wanted. The body is made of malleable iron, the wheels and axles of steel suitably mounted on roller bearings.

Loading is eased by projecting skids on each side of the truck. The wheels lock sideways while the truck is being loaded. The truck in operation is easily pushed, as the wheels run without friction and those on the center axle are larger than on the ends, permitting tilting and easy guiding.

The dollys are made in two sizes, 24 in. and 32 in., and are provided with holes for attaching any special skids, body or platform required.

Niles-Bement-Pond "Super Drive" for Planers

The Niles-Bement-Pond Co., 111 Broadway, New York, N. Y., has developed a reversing-motor drive for use on planers that operates by



Niles-Bement-Pond "Super Drive" for Planers

means of a direct current adjustable speed motor.

The reversing motor is connected directly to the planer, the current being furnished by a generator, driven by a motor that uses alternating current from the main line. The connections between the planer motor and the generator are never broken when in operation.

The control of the planer motor is obtained by the field current of the generator. An oscillating-drum switch, operated by dogs on the table of the planer, controls the reversal of the generator field, which in turn changes the direction of the generator current, reversing the direction of the planer motor.

Reduction of the field strength in the generator lowers the voltage of the generated current, permitting speed changes of the planer motor. Separate hand-operated rheostats control the changes in the field current for the cutting and return stroke, so that various speeds may be applied within the range of the equipment.

A pendant switch, suspended on the cross tie of the planer, controls the starting, stopping and reversing.

The generator and driving motor are mounted on one base and may be positioned to suit, the only connection required being by wire.

The arrangement makes a controller with a multiplicity of relays and contactors unnecessary and affords protection to the drive against possible failure of the line voltage.

Cutting speeds from 25 to 60 ft. per min. are available and return speeds may be run as high as 160 ft. per minute.

Erratum

The address given as Covington, Ky., for the Covington Machine Co., on page 636, Vol. 62, in connection with the description of its hose dismantling and assembling machine, should have read Covington, Va.

News of the Week

Sales Problems Discussed by National Machine Tool Builders' Association

Enthusiastic meeting tentatively adopts ethics code

At the 23rd semi-annual convention of the National Machine Tool Builders' Association, held in Buffalo, April 29 and 30 and May 1, the principal topic was sales promotion. The usual group meetings were held on the first day of the convention instead of on the last day as in the past.

The first regular session convened on Thursday morning and listened to reports from the president, general manager, treasurer and chairman of the membership committee. The feature of the session was the comprehensive report of the code of ethics committee consisting of A. H. Tuechter, Fred L. Eberhardt and H. M. Lucas, chairman. The Association adopted formally, at the last annual meeting, the code of ethics of the Chamber of Commerce of the United States. In the meantime the committee worked out all the practices destructive of each of the fifteen principles of the code and set them down in its report. After some discussion the code as expanded was tentatively adopted until the annual meeting when a whole session will be devoted to discussion and amendment for final adoption.

At the afternoon session reports were heard from the advertising committee and from the three regional committees on market research. A very able paper on what can be done to improve the advertising of the industry was presented by E. P. Blanchard, Bullard Machine Tool Co. It was voted to recommend to the board of directors that funds be made available for the hiring of a copy-writer to provide copy for a period extending to three months beyond the end of the fiscal year.

Sales Training Discussed

On Friday morning the members listened to a talk on the training of salesmen by Dean W. W. Charters, Professor of Marketing, University of Pittsburgh. As a result of discussion, following Dean Charters' remarks, a committee was appointed to look into the possibilities of applying the principles stated to the practical needs of the machine tool industry.

The other paper presented at this session was one on the advantages of the one-price policy, by H. W. Dunbar, Assistant Sales Manager, Norton Co. The speaker discussed the various methods of deviating from this policy and showed why each one was indefensible.

At the final session C. F. Meyer, Foreign Sales Manager, Landis Machine Co., read a paper on conditions in South America in which he urged the machine tool builders to pay more attention to this field. He was followed by W. F. Rastall, Chief of the Industrial Machinery Division, Department of Commerce, who pointed out that the English and German builders of machine tools are able to export about twice as large a proportion of their output capacity as are American builders.

In his address President O. B. Iles said in part:

"Out of the regional meetings of our Association have come some ideals which, if followed up and worked out to conclusion, will greatly benefit the machine tool industry as a whole. But to reap this benefit requires the interest and co-operation of our whole membership.

"Your Board and Officers would like to institute a line of research regarding the sale of machine tools that would cover the whole field in all its details; to get together a report that would give the executives of machine tool establishments facts that would enable them to plan intelligently for the present and future. Suppose we made an investigation that would show the plant capacity in the United States for each type of machine tool manufactured, the possible and prospective fields of outlet, the cost of selling machine tools by advertising in trade papers, by direct mail, by expositions and shows, agents and salesmen, and finally the cost of engineering service and demonstrations.

"If each member would enter into this plan in a whole hearted way, we could accomplish something. If each member were willing to dig into his records for a few years past and contribute his share of information, we would get facts of tremendous value. If we co-ordinate the information gathered by statistical organization, other trade associations, colleges, the Department of Commerce, our own trade papers, and other trade papers, we can help our industry. But, gentlemen, it will take the whole hearted and honest co-operation of each of us.

"After such a study is made for the United States, it can be done for the civilized world, taking the nations in their importance as markets for machine tools. Most of us realize that we have not used our Government representatives in foreign countries to the extent that we should. We have not used our representatives to the extent that other industrial nations have used theirs. Yet they are ready to lend the fullest co-operation, if we will let them know in a definite and specific way what is wanted.

"You will agree that in order to plan successfully any business enterprise and its operations, it is necessary to have facts on which to base a sound plan. If our plans are based upon sentiment or whims or fallacies or errors, then our business cannot be successfully operated. If each of us is arriving at a judgment by our own individual experiences, through trial and error, then there must necessarily be many plans that work out in a very wasteful and haphazard manner. If we are able to combine our experiences, it stands to reason that we can save a lot of waste. This is really constructive work from which each of us would draw more than he put into the combined pot.

Would Facts Convince?

"Suppose we were able to show facts in regard to the capacity of twenty plants making certain types of machine tools. Suppose we could show facts in regard to the possible outlet for their product. Suppose that putting these two things together would show any one of the twenty plant making these particular tools could make enough to supply the probable demand for years to come. Would it not spur the executives of these plants to a realization of the actual conditions, and cause them to change their plans? Would it not give them the basis of good business judgment for the future as far as the manufacture of those particular tools is concerned? Would it not cause some of these manufacturers to produce something far superior to their competitors? Would it not cause others to change their product to something whose chance for success and profit is better, instead of hanging on in the vain hope that a mysterious something will happen to save their assets before they are all dissipated?

Marketing is only one of many subjects connected with the machine tool industry that can be dealt with by research and survey, if only the membership would fully realize what can be done; if every one of us would honestly co-operate.

"I have said this much to renew your thoughts along this line, and to enlist your active and whole-hearted support when the Market Research Committees present their proposals for action and ask for your support."

The general manager's report was very well received. Space limitations prevent its complete publication but certain of the more important statements follow:

"Our barometer reports show that there has been steady improvement in

the state of business since last June, although the figure is still much below capacity. Members who have brought out new designs of marked improvement over older types are quite naturally getting some replacement business from users that are able and willing to give orders.

"In the last analysis, the machine tool industry never has had anything to sell but production efficiency. It has always had to sell the production idea first, after which its customers brought themselves to buying machine tools that would carry the production idea out in practice. Now with the industries of the country continuing, as they have for some years, on a conservative policy, there is no rush of expansion demand to sweep the machine tool business into a peak of real profits. The business that is coming out is mostly replacement business, with only such small expansion business as comes from isolated cases. Both replacement and expansion demand naturally goes to the more up-to-date designs in greater proportion than to the less efficient designs. In either case, the user will buy the type of machine that will give him the cheapest production per dollar of capital invested. In times when there is little expansion, even the best of machine tools need a lot of selling.

Co-operative Research

"We have pointed out on other occasions that the machine tool industry would well profit from co-operative research that would solve some fundamental technical problems of interest to large groups of the industry. Some of these problems are too big for any one concern to handle. They involve questions of such general interest that no one can be blamed for not shouldering a burden that should rest on the whole industry. They remain unsolved, because our industry has not yet seen the wisdom and economy of co-operative solution of such important problems.

"One may well wonder why this industry does not make use of research facilities ready to hand in well equipped laboratories in every state where any fair number of machine tools are made. The industry pays to support these laboratories through taxes, in many cases. It is a curious and a costly inertia that prevents the machine tool industry from using these laboratories as other industries do. Merely by asking, we can get valuable work done in some cases. In other cases, small sums spent for a little equipment would make available much other equipment already provided. Isn't it rather foolish not to take advantage of some of the opportunities that are ready to hand?

"As time goes on, it is apparent that the problems of this industry are not well understood by the users. This creates strained conditions that can be avoided only by contact and publicity. Machine tool users as a class do their heavy buying in short, sharp spurts, and do not buy in any fair quantity for relatively long periods. Therefore, most of the time the builders are asking, 'How can we improve our sales?'

"Necessity for sales is a prolific mother of inventions that advance the productivity of machine tools. Since 1922 the advance in design has made obsolete large numbers of machine tools now in use, so that they are truly liabilities, and not assets to their owners.

"In spite of the higher costs of production with old machines, the builders find many large users slow to replace them. Machine tool salesmen often sell the shop men on the productivity of their new tools, but find their sales hanging fire, because the financial men will not approve any purchases of equipment, no matter how profitable it would be in service.

"Few of our salesmen can get higher up than the chief production men of the large users. From there on, the user's production men have to sell the investment to their financial superiors. So the builder is depending on others to complete his sale, and he often finds it gone stale. Sales will continue to go stale until our industry finds means of getting to the men higher up, and finishes its own job of selling.

"At times there is another, and a very great obstacle to be overcome. It lies deep, and its overcoming requires much greater selling finesse than any straight-out salesman can bring to bear. That obstacle is financial executive policy. If at a given time the financial control decides to clamp down on equipment purchases, no selling finesse can drag an order out of the company's purchasing agent. The big problem of the machine tool industry is to show high executives of its big customers the disadvantages of peak load buying. When to buy is a matter of executive policy, so it is necessary to get that policy changed if the machine tool industry is to gain greater stability in employment and operation. Certainly no mere salesman can reach the men who dictate the general buying policy of big industries.

Reach the Executive

"How to reach such men is the next question. Some will say that they are entirely out of our reach; but that idea is a mistake. Any high executive can be reached by other executives who are known to have solved some executive problem that has puzzled him. Successful machine tool executives deal with most complex problems, because theirs is a most irregular and complex industry. They are experts at solving some problems that puzzle other executives. If other executives only knew how much an experienced machine tool man could help them, they would welcome the machine tool man to the inner sanctum.

"But how are these other men to learn of the machine tool men's abilities? One way is for our machine tool men to write articles on the executive problems they have studied and solved. Editors of our own industry's papers are delighted to print such articles. It is good business to write them because the one contributing knowledge to others gains in their estimation and good will. Give us good papers for our own conventions. Get reprints of them, and distribute them where they will do good. Then step outside of our own ranks, do what men in other industries do to let their light shine before men."

No Serious Recession of Business Expected

Business continues to show a general tendency toward contraction in productive activity in response to a need for adjustment of production to consumption, says a bulletin from the National Industrial Conference Board. Commodity prices show a downward movement, which is perhaps most significant in metals. Building construction and manufacture of automobiles are the chief exceptions to the industrial recession. This decline has been characterized as a deflation of overoptimism with no serious impairment of the basic elements of prosperity. Perhaps the chief complaint against business conditions arises from the receding margin of profit. In steel, automobile tires, retail stores and sundry other lines, the ratio of profits to sales has been falling for the past few weeks. The correction of this condition constitutes one of the present problems of management.

The first quarter of 1925 has brought to completion a period that may well be termed the first phase of the business recovery that began late last year. A survey of the best available statistical series, showing business changes over a period of fifty years, shows that there have been only three instances during this time in which recoveries of general business have run over longer periods without receiving their first minor setback. These recoveries were those following the depression after the Civil War, the serious panic and depression of 1907 and the industrial prosperity following the outbreak of the World War. A summary of the situation for the first quarter discloses that the output of iron and steel has been greater than for the first quarter of any previous similar period; carloadings and bank transactions have made new high records for this time of year; automobile manufacture has been steadily increasing; industrial employment has increased, with a notable absence of serious labor disputes; the agricultural situation has improved and the price structure has remained in better balance than one year ago.

Expressions of opinion in financial circles concerning the present evidences of business hesitation justify the conclusion that any recession will be more moderate than it was in the spring of either 1923 or 1924.

Export Figures Close to Record Months

Exports in March were larger than in any month in four years, with the exceptions of October and November, 1924. In only one month in four years have the imports exceeded those of March. Thus are the prophets of disaster confounded, says Commerce Secretary Hoover, referring to those who were so sure that the Fordney-McCumber tariff act would wreck our foreign trade.

A significant point is that the major increase appears to be in partially manufactured goods which is proof of better conditions abroad. Increased imports of raw materials indicates improving business at home.

Ackles Is Re-Elected President of the Supply and Machinery Distributors

Many topics of interest discussed at annual convention

At the Ambassador Hotel, Atlantic City, the National Supply and Machinery Distributors' Association met April 27 to 29 for its twentieth annual convention. An open session started at 11 a.m. Wednesday, and there was a joint session with manufacturers at 4 p.m. and another on Tuesday afternoon. Other sessions were executive.

President B. H. Ackles, of the T. B. Rayl Co., Detroit, opened the first session with an address in which he pointed out that the association is now 20 years old and has grown from 22 to over 200 members. He commented on the desirability, from the manufacturers' point of view, of having strong and prosperous distributors able to carry adequate stocks and pay bills promptly.

The secretary's report was read by George A. Fernley who said that the average cost of making a sale is 21 per cent. He urged the members to charge interest on past-due accounts, to go after profitable business rather than merely volume and to make use of the facilities of the association on such matters as credit reports and taxation relief claims. According to statistics there are 84 distributing houses represented in the association that can deliver over a radius of 150 miles in 12 hours or less, and that have stocks worth at least $250,000.

A half dozen speakers then commented on present and future business conditions, the concensus of opinion being that conditions now are sound with the promise of better things ahead. The months of December, January and February produced fair average business, but rather less than the optimists had looked for. There was a let-down in March, but the last few weeks have seen a distinct change for the better.

It was pointed out that labor costs are double those of 1914 and that material costs are some 75 per cent higher. Prices have increased only 65 per cent. A need for more real salesmen and fewer "order-takers" was voiced.

Entertainment features consisted of a banquet on Monday evening and a swimming exhibition in the Ambassador pool, followed by an informal dance on Tuesday evening.

At the closing session the following officers for the ensuing year were elected: president, B. H. Ackles, Detroit; 1st vice-president, T. W. Carlisle, Cleveland; 2nd vice-president, E. H. Welles, Chicago; advisory secretary-treasurer, T. James Fernley, Philadelphia; secretary-treasurer, George A. Fernley, Philadelphia; executive committee, J. H. Orem, Jr., Baltimore; L. B. Shaw, Chicago; W. B. Hunn, New Haven.

Employee Training Will Be Discussed at Chamber of Commerce Meeting

Group session to hear addresses on individual production

Incentives for individual production and employee training are two important manufacturing problems to be discussed at a special group session held in connection with the thirteenth annual meeting of the Chamber of Commerce of the United States at Washington, May 20 to 22. This group session, which is being arranged under the direction of the Chamber's department of manufacture, will be attended by leading manufacturers from all parts of the country. Several prominent executives will discuss the subjects.

E. W. McCullough, manager of the department, in announcing the program for the special group meeting, stated, "that at the present time the producers of the country are faced in many lines with what is commonly called a 'buyer's market'—that is, the demand apparently does not exceed the possibilities of supply and the buyer naturally is exerting pressure for lower prices and better selling terms.

"In such situations competition forces a search for waste, means for greater efficiency in production as well as stimulated sales efforts. This is simply another way of describing the evolution that is all the time going on in eliminating the obsolete and inefficient.

"As production in all lines is controlled to a very great extent by the human element—the workmen—it is but natural that the employer should in such times review his industrial relations and see where they can be improved, to the end that he may not only get continuous production but more of it without increasing his outlay.

"The study of individual production has been reduced to a science and almost innumerable plans have been tried. The appeal must naturally be made on a basis which will have the interests of both the employer and the employee in mind in order that it may succeed and have continuity.

"Under the heading of 'Incentives for Individual Production,' this whole question will be discussed before the manufacturers' group meeting by W. C. Dickerman, vice-president in charge of operation of the American Car & Foundry Co., which concern has nineteen plants in various parts of the country.

"The second topic of equal importance at the group meeting is that of 'Employee Training.' This subject will be dealt with by L. A. Hartley, Director of Education of the National Founders' Association."

In connection with this subject, Mr. McCullough said that "labor turnover is a fundamental problem of all employers. Drifting labor—the kind that moves from place to place during the periods of trade expansion and depression—has been found to be most expensive. Many employers, appreciating the value of labor continuity, have changed their policies from more selection and are now considering and in a large number of instances conducting practical training in order to develop the best in an employee, and to afford him opportunities for advancement. In the past, the second generation of employees has received little attention and the sons of good workmen have frequently drifted away from their father's employer who could offer them better opportunities than they are likely to secure in drifting from place to place.

Training for Efficiency

"Employee training does not necessarily imply apprenticeship or the development of journeymen owing to the many lines of service in which labor is engaged, but it means rather training for the highest efficiency, to the end that an employee may through his own efforts rise to his opportunities and the monetary reward which is sure to follow.

"Mr. Hartley will develop this subject from his experience with many lines and the information he will bring to this meeting may be looked forward to as not only of exceeding value but practical in its application.

"Following the delivery of both these addresses, ample time will be allowed for question-asking and the discussion of these problems. Both these speakers have generously agreed to conduct these discussions and will also be assisted by the members of the Advisory Committee of the department, all of them experienced manufacturers dealing with these same problems."

Russian Market Shows Improvement

In no country more than Russia are the users of machinery so convinced that American products are superior. This applies to industrial as well as to agricultural machinery.

The preference of the Russians for American machinery antedates the war. A large amount of American machinery had been introduced into Russia prior to 1913. This gave those concerned ample opportunity to become familiar with its merits. Considerable amounts of American machinery were installed in Russia during the early part of the war.

Apparently there is a determination in the country to have American-made machinery. The fly in the ointment is the inability of many of those who would buy to finance the purchase. There also is the obstacle of an arbitrary and whimsical government, which is constantly juggling with orders for foreign goods.

With all of this to discourage business, American machinery is going to Russia in constantly increasing volume. It is expected that this business will improve during the next few months.

Personals

W. F. BARRETT received the honorary degree of Doctor of Science from the University of Pittsburgh, at the recent Charter Day Exercises, in recognition of his achievements in the production and commercialization of industrial gases.

Mr. Barrett, shortly after graduation from Sheffield Scientific School, Yale University, entered the employ of the Peoples Gas Light and Coke Company, Chicago, and ten years later was appointed assistant general superintendent and assistant chief engineer. In 1913 he accepted the position as works manager and chief engineer of the Linde Air Products Company. At that time the consumption of oxygen for cutting and welding was of modest proportions. Mr. Barrett recognized the possibilities of the oxy-acetylene process and has been an important factor in directing its development. Mr. Barrett is now vice-president and director of the Linde Air Products Company, president of the Dominion Oxygen Company, Ltd., vice-president and director of the Prest-O-Lite Co., Inc., and a director of the National Carbon Co., Inc.

G. A. PABST, who has been connected with the machine tool industry for many years, devoting most of his time to the internal grinding field, has joined the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., as special representative in the sale of G & L grinders in the United States and Canada. Mr. Pabst will have his headquarters in Chicago.

CLAUDE MURRAY has been appointed office manager for the Wheeler-Murray Company, contractors' and road builders' equipment, 335 Ellicott Square, Buffalo, N. Y.

ERNEST W. CHRIST, secretary of the Stanley Works, New Britain, Conn., has returned from a two months' trip to England and continental Europe. Stanley Works branches abroad were visited. E. Allen Moore, chairman of the board of the Stanley Works, will remain abroad a month longer.

PETER F. AUGENBRAUN, manager of the Yale & Towne Manufacturing Co., Stamford, Conn., plant at Altona, Germany, has resigned, terminating thirty-five years in the company's employ. Although born in Germany he spent most of the last forty-three years in this country. He returned to Germany nearly four years ago to take charge of the German plant. He is now in this country. E. E. Erbe, European representative of Yale & Towne at Hamburg, Germany, has been appointed Mr. Augenbraun's successor. Mr. Erbe has been in the company's employ for fifteen years. Mr. Augenbraun was tendered a testimonial dinner on Tuesday evening, May 5.

CHARLES D. OESTERLEIN, vice-president of the Oesterlein Machine Co., Cincinnati, Ohio, sailed on the Aquatania April 29 for a two to three month's business trip in Europe and England.

ALDEN M. DRAKE, formerly associated with the Heald Machine Co., is now engaged as chief engineer for the Greenfield Tap & Die Corporation, Greenfield, Mass.

C. O. TERRIS will represent the Reynolds Electric Co., Chicago, in the mid west territory.

J. FRANK DE CAUSSE, specialist in the designing and construction of custom-built bodies, has become associated with the Franklin Automobile Co., as manager in charge of the custom car department.

H. D. CHURCH, formerly Assistant Chief Engineer of the Chevrolet Motor Company, has become director of engineering for the White Motor Company of Cleveland, effective May 1.

Business Items

At the annual meeting of shareholders of the Stevenson Gear Company, Indianapolis, the election of a new board of directors was held. The new directors are: William L. Hutchinson, G. E. Stevenson, Carlin Shank, Guy Wainwright and Harry Callon, all of Indianapolis; J. E. Fulwider, Greentown, and John Hodges, Zionsville. The directors will meet within the next two weeks and elect officers.

The shippers' regional conference board for New England will meet in Boston, May 8. Composing the group are Col. Samuel M. Nicholson, president of the Nicholson File Co., Providence, R. I.; Henry D. Sharpe, president of the Brown & Sharpe Manufacturing Co., Providence, R. I.; S. H. Bullard, vice-president of the Bullard Machine Tool Co., Bridgeport, Conn.; E. Kent Hubbard, president of the Manufacturers' Association of Connecticut, Inc., Hartford, Conn.; C. F. Hollister, treasurer of the American Brass Co., Waterbury, Conn.; R. W. Poteet, traffic manager of Stanley Works, New Britain, Conn.; and A. D. Fiske, traffic manager of American Steel & Wire Co., Worcester, Mass.

The Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has consolidated its two New York offices, one of which was formerly located at 50 Church St. and the other in the Times Building. The new offices are located at 8 West 40th Street.

Link-Belt Company of Indianapolis, Chicago and Philadelphia, has just announced that after many years of work and study of the problem of standardizing and manufacturing silent chain drives for stock, it has placed in operation a new plan by which complete lines of silent chain drives of from one quarter to ten horsepower, in practically any reduction from one to one to seven to one, are now available for immediate delivery, by distributors located in many principal cities of this country.

Obituaries

WILLIAM H. WILEY, for 41 years treasurer of the American Society of Mechanical Engineers, died on Saturday, May 2, in New York.

Mr. Wiley was born in New York City in 1842. He received his A.B. degree from the College of the City of New York in 1861 and his C.E. degree from Rensselaer Polytechnic Institute in 1866. He was a student at the Columbia School of Mines in 1868.

At the outbreak of the Civil War Mr. Wiley joined the Seventh Regiment of New York Volunteers and in 1862 was made first lieutenant, U. S. Volunteers. When the regiment was mustered out in 1864 he was given the title of Major, U.S.V., for services in the field.

Since 1876 Major Wiley had been a publisher of scientific works. He served as a member of the 58th, 59th and 61st Congresses from New Jersey. In 1897 he was president of the International Jury of the Brussels Exposition, and was a member of the Superior Jury, Brussels. He received the decoration of the Order of Leopold. He was commissioner from New Jersey to the St. Louis Exposition in 1904.

Major Wiley had been a member of the A.S.M.E. ever since its organization. He was appointed to the finance committee in 1882 and while serving as chairman of this committee was elected treasurer of the society. In the forty-one years which have elapsed since then, he had been regularly nominated and elected to this office.

Major Wiley was the author of a book on the Yosemite, Alaska and the Yellowstone. He acted as New York correspondent for London *Engineering* for 29 years. He was a member of the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Association for the Advancement of Science, the National Geographic Society, the Order of Leopold, Belgium, and the Loyal Legion.

CHARLES P. WETMORE, widely known designer of metal working tools, died April 28, at the age of 62 years, at his home in Milwaukee. He was secretary and chief engineer of the Wetmore-Gibbons Co., engineers and designers, with offices at the A. O. Smith Corporation, Milwaukee. He established the Wetmore Reamer Co. and numerous other concerns to manufacture and market his inventions.

WALTER S. HAGAMAN, for over twenty-five years associated with the W. E. Shipley Machinery Co., Philadelphia, died on May 1, in the St. Charles Hospital, St. Charles, Ill.

Mr. Hagaman became associated with Mr. Shipley, laying the foundation of this business in 1898. Failing health compelled him to retire in August, 1922.

JOHN NICOL, manager of the Massey-Harris Harvester Co., Inc., of Batavia, N. Y., branch at Saskatoon, Saskatchewan, died suddenly on April 23 in his 40th year.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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IN SPAIN the newspapers are permitted to publish the Bourse quotations, but they are not allowed to comment or amplify upon them when the markets are declining. A recent article in the *Living Age* is my authority for this statement, and I found myself wondering how a similar restriction would work in America as I read the articles published in last week's newspapers under the captions that follow:

"Pittsburgh Output of Steel Declining," "Cotton Mills Cut Down Operations," "Output Declines," "Cuts in Steel, Iron and Lead Disturb Business in Chicago," "Copper Mine Output is Due for a New Cut," "Steel Mill Operations 80 per cent and Still Falling," "Rail Rates Drop but Wages Climb," "Prices are Lower in Half of Steel Products," "Steel Shipments Decline in Midwest," "Middle West Puzzled at Slackness of Trade," "Closing of Two Banks Laid to Coal Wage," "Industrial Output Declines in March," "Output Falls Lower in Basic Industries," "Building in Danger of Going Too Slow," "More Irregularity in Western Business," "Auto Producers Move with Caution," "Auto Makers to Slow Down."

The text of all these articles is in the main accurate and so qualified that their apparent pessimism is mitigated, but in their haste the "head writers" seem to have drawn conclusions that are not wholly warranted and as most business men read but little more than the headlines a feeling of depression is being unnecessarily created and spread. This is unfortunate, for there is no true depression in business.

A readjustment in the cost of production and selling prices is in progress. It is salutary because it will ultimately bring an increased output within the purchasing capacity of consumers and it ought to be encouraging rather than discouraging.

But the American people have always regarded advancing prices as a reflection of prosperity and it is hard to convince them that the reverse is the fact. That wealth consists of the consumable or useful things that we possess rather than of increased bank credits is a truth that is not generally grasped but it is fundamental and it is the duty of those who have the public ear to drive it home.

That lower prices for most products of industry and ultimately lower wages are now indicated is undeniable. But as a result of increased efficiency and the use of labor saving machinery the cost and selling prices of *things* will decline more and more rapidly than wages. As a result a day's labor will buy more, an increased production can be sold, more wealth will be created and the standard or scale of living will be advanced.

This process has now commenced. Its continuance appears to be inevitable and while it may cause some inconvenience and compel economy for a time it will not be either depressing or distressing if we take it philosophically and interpret it aright.

This view is stressed because it is plain that the headlines quoted and others like them are creating an illusion of hard times here or at hand that is utterly unwarranted. There is nothing the matter with business in this country that lower prices will not cure, and that cure is commencing to be applied in many quarters.

What's Doing in Industry

Conditions in the machine tool markets show a satisfactory trend, judging from the reports coming from the more important centers.

The impression that has been created by loose talk and irresponsible newspaper propaganda has had a tendency to undermine public confidence in general business. Nevertheless the temporary readjustment now going on, accepted in many quarters as a depression, has brought about a stabilization of production costs in some of the key industries and has had a stimulating effect on buying by making selling prices more attractive.

The demand for machine tools and accessories has been spotty during the past few weeks. The railroads have confined their purchases to immediate necessities. Inquiries have been received for equipment for several new railroad shops or additions now in process of construction but these do not affect the present market.

The automotive industries have been mildly active in purchasing equipment for replacement and slight expansion. Labor-saving machines and small tools have been in demand from many localities.

Orders from abroad have taken on a new complexion, perhaps encouraged by the more stable condition of British finance. Germany has entered the market with several orders and other foreign countries are reported as being ready to place orders for new equipment.

The bituminous coal industry, for example, is in a bad way because power can be more cheaply obtained from the hydro-electric plants or by the use of oil. Therefore, coal is likely to decline until it can meet the competition, and when it does there will probably be a demand for all the power that is available.

Rubber is another article that is selling at a "managed" price and the tire manufacturers are in consequence asking more for their product. The result will probably be a smaller demand and upon this theory rubber seems high enough if not too high.

The gradual decline in steel and the poor demand for most other metals is the direct result of the slackened building activity which is in turn due to the high wages. As one of the headings quoted says, "Building Is in Danger of Going Too Slow," and there is certain to be more of it when building material and labor cost less.

The stock market seems to be coming to an appreciation of the benefits that must follow the downward revision of commodity prices and wages that is in prospect, and the tone toward the end of the week was distinctly firm. There is no boom and but little speculation, although money is easy and the weekly statement of the Federal Reserve System indicates a continued abundance of credit.

Were it not for the chilling effect that drooping commodity prices are likely to have upon sentiment stocks might be bought with confidence, for Great Britain's return to the gold standard is likely to have a profoundly stimulating influence upon security values throughout the world.

It has already allayed the apprehension caused by Hindenburg's election and has made it easier for Caillaux to secure consideration for proposals that contemplate higher taxes and increased governmental economy in France.

It is rumored that he intends to offer the French Antilles and French Indo-China to the United States in settlement of the debt due us. This rumor is probably the fanciful invention of some French journalist, but it is at least interesting although it is unlikely that we would be willing to increase our responsibilities in the Orient. But the suggestion serves to show that Europe regards us as a nation whose interests and power are all embracing, as in fact they are.

This being the case we can hardly fail to share in the economic renaissance and return to normalcy through lower prices that now impends abroad, and for it we should immediately prepare ourselves.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Cleveland

A steady improvement in the machine tool industry in this district is evidenced by the placing of a fair volume of business with local manufacturers and dealers. The majority of the orders received were for single and small pieces. This, combined with the fact that they were from all parts of the States and from diversified lines, would indicate that business in general is on the increase and that manufacturers are striving for better production and greater efficiency.

Several plants are operating within 25 per cent of their full time and they are all hopeful that by June first they will be running one hundred per cent.

The construction of twelve new buildings for foundry and machine shop purposes in Cleveland will have a tendency to increase business for the trade.

Inquiries are more numerous, structural steel fabricators, automotive and railroads leading in this respect.

Automatics, planers and lathes are very active while the punch and shear market is quiet.

Cincinnati

A fair increase in demand for machine tools of all kinds is reported this week by the majority of Cincinnati manufacturers and dealers. The out-of-town market is more active than the local, it is stated, but both markets are improving visibly. No big lists of requirements have been purchased in their entirety, and the tendency still is to order one tool at a time.

The automotive industry is ordering more freely than it has been, but none of the purchases are what may be called large. Railroads continue to send inquiries, but while their purchases have increased to some extent they are still small in comparison to their needs. Machinists and general industrial plants are sending an increased number of orders, these coming from all sections of the country. The demand for replacement parts still continues to grow.

That the foreign market has at last commenced to open up is indicated by the fact that fair-sized orders for large lathes and also for various smaller tools have been received from England and Germany. Some orders also have been received from the paper industry of Canada.

Domestic orders received have come from all sections of the country, North, South, East and West, and inquiries are likewise scattered over all sections. A buyer from the Pacific Coast has just arrived, coming for the purpose of purchasing machine tools of various kinds in this market.

The common feeling among the trade is that there is nothing discouraging in the situation, and on the other hand there is much to give encouragement. The peak is climbing upward constantly, it is pointed out, and business conditions are gradually returning to normal, not merely in one section of the country, but in all localities.

Chicago

The Chicago machine tool market continues without special features indicative of immediate activity. Dealers report inquiries to be fairly satisfactory and express themselves as hopeful, if not actually confident, of an improved situation within the next month.

High School inquiries for machine tools to be employed in technical shops are announced from Grand Rapids, Mich., and Rockford, Ill., the former including 30 items and the latter 21. The Atchison, Topeka & Santa Fe R.R. is in the market for additions to its equipment, to include one vertical, high-power drilling machine, with a capacity of four in. in steel and a 24-in. reach; also a 2-in. double-head bolt cutter.

Chicago newspapers are carrying display advertisements of an auction of a large number of machine tools of varied descriptions, together with special machinery comprising the entire equipment of the Sims Magneto Co., East Orange, N. J., all of which are listed in detail. Up to date, the Illinois Central R.R. has not placed its order for the machine tools needed for its Markham yard.

Buffalo

No change is noted in the machine tool trade of Buffalo since last month. While general trade conditions seem fairly good, industrial and machine tool trade conditions are still extremely spotty. The tone is optimistic but not overly so.

Several dealers reported absolutely no change in their own businesses during the last thirty days. They also reported that none were in sight. There were a few such cases in which the optimism was at a very low level and this had every appearance of being justified.

The railroad shops are particularly quiet and this is true of some of the railroad equipment industries operating in Buffalo, some of them operating only three, four and five days per week.

On the other hand the automobile and automobile specialties field is fairly busy. But the chief buyer in this field, the Pierce Arrow Motor Car Company, was completely equipped for the production of its new series more than a year ago and is rarely in the market for even single items these days.

One dealer reported that the month had been a good one for him but that he could not consistently say that this was indicative of general business in the trade, inasmuch as most of the orders were from old prospects who had been preparing to buy the items sold for several months.

One bright spot in the situation lies in the fact that those dealing in contractors' equipment are extremely prosperous. The demand for road-building machinery including pavers, cranes and the like, has been good since the first of the year and took on added interest shortly after April first. There is to be an enormous amount of road building and paving done in this part of the state this season.

In addition to the equipment for contractors in road building, three new schools are to be built in Buffalo, as well as a large stadium at Niagara Falls and some industrial construction besides, all running into millions of dollars. This will naturally take considerable equipment.

The Buffalo-Ft. Erie Bridge project seems assured of going through within the near future and this operation will naturally take a large amount of equipment.

In the strictly machine tool line no orders of importance were reported, the best being one of five radial drills going to the American Tool Works.

Detroit

Sales of machinery and machine tools in the Detroit district remain at practically the same level as that maintained since the first part of April, with a large proportion of inquiries resulting in orders and with the automotive plants leading the way in the purchase of new equipment and tools.

Steady and regular increases in the production schedules of practically every leading automobile manufacturer has had its effect upon the machinery firms that are handling a larger volume of sales than at any time this year. The present demand seems to be for special machinery, with the Ford Motor Co. leading the field in its effort to reduce the cost of products by the installation of more modern machines.

Inquiries have been received from the Briggs Manufacturing Co., the Owosso Boiler & Welding Works, and the Blackmere Rotary Valve Pump Co. of Grand Rapids.

Additional equipment is being purchased by the Stout Metal Airplane Co. with which the Stout plant, located

at Henry Ford's airport at Dearborn, can enter into quantity production. Jigs used in the fabrication of wings and fuselages on the first four planes constructed by the company will be used when the factory starts anew, but some of the machinery of the shop will be changed.

Since the middle of February the increase in employment in Detroit factories has been between 35,000 and 40,000, a sign of the healthy condition of industry in this city.

New England

Buying during the week just closed was widely scattered, so far as distribution was concerned. Manufacturers in New England report that the trades buying well were those engaged in production for the electrical, automotive and railroad industries. Machinery demand for the electrical trades is heavy and is construed as indicative of presence of existing demand not altogether planning for future requirements. Buying in the automotive field at the present time is of the replacement variety and is of good volume. Railroad buying by Southern railroads has been considerable.

The past week has witnessed much activity in shipments and at rail centers it is stated that the freight tonnage for machinery during the first three months is about fifteen per cent higher.

The demand for hand tools continues to be of the same high level commented upon by various manufacturers during the past three months.

Foundrymen report an increased demand for castings. In Bridgeport, New Britain and Hartford reports indicate that all available furnaces are being utilized. In Bridgeport employment in this branch of the industry is increasing.

Additional employment has been going on in shops in Bridgeport and Hartford for the past several weeks. Hiring has ceased for the time being in Hartford and in one of the shops the working schedule has been curtailed.

Canada

Reports from Eastern centers show a decided improvement in the demand for machine tools and plant equipment. A betterment in the warehouse trade is reported from all sections of the country. Toronto resale men, who found trade the first two weeks of April decidedly below the average of the first quarter, are now busy and regard the future with optimism.

Reports from Vancouver are to the effect that large quantities of mining machinery are arriving on every vessel from the South, destined for the mines of British Columbia.

Announcement of the restoration of the McKenna duties by the British government has been received with satisfaction by Canadian automobile manufacturers. These duties, which are effective July 1, give a preference to imports of automobiles made in any part of the British Empire. They expired a year ago and were not renewed by the late labor government.

The export demand for Canadian-made automobile parts is steadily increasing and shipments are now being made to 23 different countries.

Besly—Chicago—50 Years

Anniversary catalog shows progress of half century

In 1875, Charles H. Besly & Co. started business in Chicago. Today, fifty years later, you will find "Welcome-Besly" still on the doormat. To those who knew Charles Besly personally, the sign on the doormat was typical of the man, and this characteristic of geniality played its part in building up the business during its earlier and struggling days. Since that time the company has developed greatly, not only as dealers, but as manufacturers of a well known line of grinding machinery, abrasive supplies, taps, etc.—and the Besly spirit still prevails.

Fig. 1—The Besly plant from 1875 to 1906

In celebration of the fiftieth birthday, Besly has issued an anniversary catalog of over 800 pages that is the last word in publications of this kind. This catalog shows, perhaps better than anything else could do, the advance that has been made in machinery supplies during the past half century. In fact, it is almost an encyclopedia of machine shop equipment, the index alone occupying 23 pages.

The book is well arranged, in sections showing similar equipment so far as possible, and in compact form. There are several thousand illustrations, and sizes, weights and prices are given as well as many standard tables along different lines.

The Besly Company makes its own machines in Beloit, Wis., the plant being shown herewith. Up to 1906 the work was carried on in the little building shown in Fig. 1, but in 1906 the first section of the shop shown in Fig. 2 was completed. In 1910 a new section was added, increasing the space 50 per cent. Another addition, in 1915, doubled the plant, making it four times as large as at first and plans have been made for future expansion that will increase the present floor area by 60 per cent. Here are manufactured the grinding machines and accessories, "Boxite" and "Crystox" grinding disks or circles and Besly taps of many kinds.

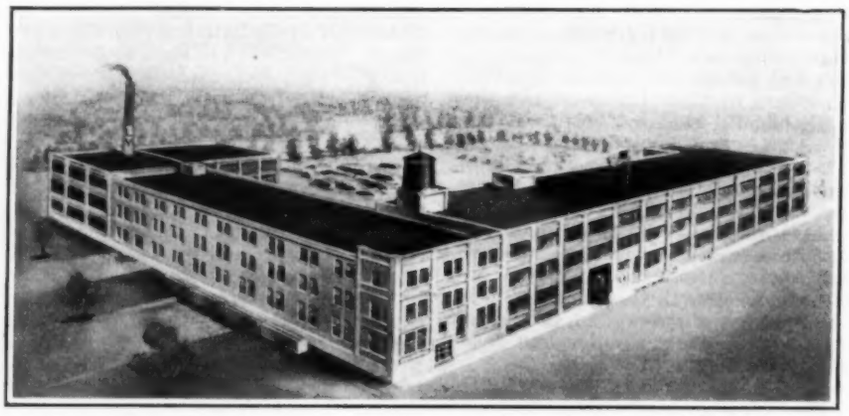

Fig. 2—The modern factory built by Besly in 1906 and since expanded to nearly four times its original size

Meeting of Cleveland Section of S. A. E.

A meeting of the Production Group of the Cleveland Section of the Society of Automotive Engineers was held Monday evening, April 20, at the Hotel Hollenden, about 120 members being present. The program for the evening was unusual in presenting a symposium on the manufacture of connecting rods, five members participating.

H. O. Schultz of the Waukesha Motor Co. discussed the methods of the manufacture of its forged steel rods. Following Mr. Schultz came a presentation of the manufacture of the Hupmobile connecting rod by John Younger, Associate Editor of the *American Machinist*. There was a talk on the Rollin connecting rod by E. M. Sawyer, factory manager of the Rollin Motor Car Co.; one on the Chandler connecting rod by Eugene Bouton, time study engineer of the Chandler Motor Car Co., and finally one on the Cleveland connecting rod by M. Wells, research engineer of the Cleveland Automobile Co.

One of the principal differences of opinion brought out was in the method of tinning the big end to receive the babbitt bearing. The necessity of having absolutely clean surfaces at this point, preferably by wire brushing, was clearly emphasized. There seemed to be a tendency to adopt centrifugal method of babbitting the big end.

Pennsylvania R.R. Apprentice School Enlarged

The Pennsylvania Railroad Apprentice School at Altoona, Pa., has been enlarged to accomodate more than 400 students, it was announced recently. The school, which was temporarily discontinued in 1921, was reopened in January this year, but was confined to apprentices from the Altoona machine shop. Since the enlargement the school is open also to regular apprentices from the Juniata shop, the Altoona car shop, the South Altoona foundry and the middle division of the railroad.

Automobile Output Shows Increase

Production of motor vehicles in the United States and Canada in March, according to the Department of Commerce, was 332,108 passenger cars, of which 319,094 were manufactured in the United States and 13,014 in Canada, and 45,012 trucks, of which 42,923 were made in the United States and 3,089 in Canada.

In February, passenger car production was 252,785 and in March, 1924, output was 357,006.

For the first quarter of 1925 to March 31, production of passenger vehicles totaled 797,802 and of trucks 107,445, which compared with 994,274 and 100,021, respectively, in 1924.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Metal-working machinery. Cologne, Germany. Furchase and agency. Reference No. 14,443.

Metal-working machinery for the automobile industry. Vienna, Austria. Purchase and agency. Reference No. 14,506.

Internal combustion engines. Messina, Italy. Agency. Reference No. 14,638.

Power-transmission machinery and supplies. Turin, Italy. Agency. Reference No. 14,642.

Street electric railway equipment. Rome, Italy. Agency. Reference No. 14,639.

Drills and bits, machine tools, and woodworking machinery. Paris, France. Agency. Reference No. 14,600.

Drills, taps, reamers, dies and saws. Paris, France. Agency. Reference No. 14,692.

Air drills. Carrara, Italy. Agency. Reference No. 14,643.

Electric cranes. Santiago, Chile. Purchase. Reference No. 14,647.

Steam motor cranes. Montevideo, Uruguay. Purchase. Reference No. 14,595.

Steam and internal combustion engines. Turin, Italy. Agency. Reference No. 14,642.

Industrial machinery. Messina, Italy. Agency. Reference No. 14,638.

Industrial machinery. Genoa, Italy. Agency. Reference No. 14,646.

Industrial machinery and accessories. Turin, Italy. Agency. Reference No. 14,636.

Machine tools. Paris, France. Agency. Reference No. 14,597.

Machine tools. Paris, France. Agency. Reference No. 14,598.

Machine tools. Milan, Italy. Reference No. 14,637.

Machine tools. Genoa, Italy. Agency. Reference No. 14,640.

Machine tools and metal working machines. Genoa, Italy. Agency. Reference No. 14,644.

Machine tools for automobile factories and railroad shops. Paris, France. Agency. Reference No. 14,599.

Metal working machinery and power-transmission machinery. Genoa, Italy. Agency. Reference No. 14,645.

Calendar of Local Meetings

American Society of Mechanical Engineers

Cincinnati, May 7. "District Organization of Modern Apprenticeship," H. A. Frommelt. Prof. J. T. Faig, secretary, the Ohio Mechanics Institute, Cincinnati, Ohio.

Hartford, Conn., May 7. Joint meeting with Meriden and New Britain sections. "The World's Economic Conditions," G. A. O'Reilley. C. W. Mayott, secretary, the Hartford Electric Light Co., 266 Pearl St., Hartford, Conn.

Detroit, May 9. "European Conditions," H. M. Lane. C. J. Oxford, secretary, the National Twist Drill & Tool Co., 6522 Brush St., Detroit, Mich.

Baltimore, Md., May 13. "Recent Developments in Pulverized Coal as Fuel," R. K. Neade, Prof. J. C. Smallwood, secretary, Johns-Hopkins University, Baltimore, Md.

Birmingham, Ala., May 19. "Processes of Preparation and Commercial Uses of Blast Furnace Slag." C. E. Ireland. G. L. Bentley, secretary, the Ingersoll-Rand Co., 1802 American Trust Building, Birmingham, Ala.

Portland, Ore., June 22 to 25. Pacific Coast Regional Meeting.

Society of Automotive Engineers

Pennsylvania Section. May 12. Trip to Naval Air Station, Lakehurst, N. J., with talk by Naval officers.

Buffalo Section. May 19.

American Society for Steel Treating

Schenectady, N. Y. Spring Section Meeting. May 28, 29 and 30. Hotel Van Curler. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

National Association of Cost Accountants

Philadelphia Chapter. May 8. "Material Control." N. M. Cartmell.

Milwaukee Chapter. May 12. Annual election of officers.

New York Chapter. May 12. "Cost Accounting to Aid Financial Control and Forecasting." S. H. Childs.

Buffalo Chapter. May 14. Annual election of officers.

Twin Cities Chapter. May 14. A review of all previous topics of the series. Election of officers.

Cleveland Chapter. May 20. "Retailing-Reaching the Consumer," and "Uniform Costs for the Retailer."

Rochester Chapter. May 20. "Methods of Applying Selling and Administration Expenses to the Product." Prof. Charles Reitell.

Syracuse Chapter. May 20. Subject to be announced. Percy S. Brown, the speaker.

Detroit Chapter. May 21. "Experience in Simplifying the Cost System."

Trade Catalogs

Helical Springs. John Chatillon & Sons, New York City. This is a reprint of an article written by John W. Rockefeller, Jr., who is the manager of the Spring Division of the concern. "Coil Spring Calculation," "Causes of Spring Failures," "Heat-Treatment of Steel Springs," "The Manufacture of Wire Springs," and "Design of Helical Springs," are the titles used for the various chapters.

Milling Machine. The Kearney & Trecker Corporation, Milwaukee, Wis. Layout Sheet No. 12 has been issued by the corporation. Others regarding the milling machine have been described in these columns. All of the sheets are extremely useful to users of milling machines.

Portable Electric Drills. The Independent Pneumatic Tool Co., 600 W. Jackson Boulevard, Chicago, Ill. The "Thor" electric drill is recommended by this company for speed and durability. Eight illustrations point out eight features of the portable tool and there is a table of specifications on the last page.

Flexible Shaft Equipments and Portable Tools. The R. G. Haskins Co., 520 West Monroe St., Chicago, Ill. Catalog No. 38 has been issued in which are shown the various products of the company. Illustrations show different views of the tools and some of the portable tools in actual operation. Emery pencils, burrs and other accessories are included in the catalog.

Spur Gear Speed Transformers. The Hill Clutch Machine & Foundry Co., Cleveland, Ohio. Bulletin T-221, showing the industrial type of the spur gear speed transformer has been mailed out by this company. There is a general description and some notes on taking care of the machine as well as specifications.

Pneumatic Grinders. The Warner & Swasey Co., Cleveland, Ohio. Roto pneumatic grinders are described in this catalog. Illustrations show the grinder in operation and text describes the principles upon which it works. There are three types of Roto grinders and each is briefly outlined. A list of dealers handling the products is printed on the back cover of the catalog.

Reamers, Chucks and Calipers. The A. C. Bellefluer & Son Co., 81 Hamilton St., New London, Conn. The Brecho reamer drill, the Holtite chuck and the vernier side caliper, all represented in the New London territory by this company, are described in a small folder that has been mailed out to the trade.

Forthcoming Meetings

Southern Supply & Machinery Dealers' Association and the American Supply & Machinery Manufacturers Association, Joint Convention. The Atlanta-Biltmore Hotel, Atlanta, Ga., May 5, 6 and 7. F. D. Mitchell, secretary-treasurer, 1819 Broadway, New York City.

The Society of Industrial Engineers, National Convention. Hotel Winton, Cleveland, Ohio, May 6, 7 and 8. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago, Ill.

American Gear Manufacturers' Association. Ninth annual convention, May 6, 7 8 and 9. The William Penn Hotel, Pittsburgh, Pa. T. W. Owen secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Society of Mechanical Engineers. Spring Meeting. Milwaukee, Wis. May 18, 19, 20 and 21. Calvin W. Rice, secretary, 29 West 39th St., New York City.

United States Chamber of Commerce. Thirteenth annual meeting, Washington, D. C., May 20, 21 and 22.

Division V of the American Railway Association. Business meeting June 16 to 18, Chicago. V. R. Hawthorne, 431 S. Dearborn St., Chicago, Ill.

Society of Automotive Engineers. Summer Meeting. Greenbrier Hotel, White Sulphur Springs, W. Va., June 16, 17, 18 and 19. C. F. Clarkson, secretary, 29 West 39th St., New York City.

American Society for Testing Materials. Twenty-eighth annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., June 22, 23, 24, 25 and 26. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

National Foreign Trade Council. Annual Convention. Seattle, Wash., June 24, 25 and 26. O. K. Davis, secretary, India House, Hanover Square, New York City.

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Ill., in August. G. G. Macina, C. M. & St. P. Ry., 1402 Calumet Ave., Chicago, Ill.

International Railway General Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 8, 9, 10 and 11. William Hall, secretary and treasurer, 1061 W. Wabash St., Winona, Minn.

New Haven Branch of the American Society of Mechanical Engineers. Fifth annual machine tool exhibition. Sept. 8 to 11. Mason Laboratory. H. R. Westcott, chairman.

American Society for Steel Treating. Annual Convention and National Steel Exposition. Public Auditorium, Cleveland, Ohio. Week of Sept. 14. W. H. Eisenman, Secretary, 4600 Prospect Ave., Cleveland, Ohio.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Iron market continues slow; prices are about $1 per ton under a month ago and more than $1 per ton below quotations at this time last year. Steel sheets and tin plates show prospects of slightly better demand during the third and fourth quarters; these items have been slow of late. The principal heavy rolled steel products are now being quoted at $2 per 100 lb., Pittsburgh, on ordinary tonnages; smaller lots of plates, shapes and bars still hold to $2.10. A year ago, the hot rolled products averaged $2.20@$2.30 per 100 lb. at mill.

Non-Ferrous Materials—Slight reaction in foreign copper and tin markets. Lead is easier. Zinc dropped $1 per ton, during week. Show of firmness, noted in last week's market, did not hold, so far as non-ferrous metals were concerned. Linseed oil dropped 2c. per gal., April 29, in New York.

(All prices as of May 1)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	23.27
Southern Ohio No. 2	23.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	27.37
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.26
Virginia No. 2	29.17
Basic	23.26
Grey Forge	23.75
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	23.77
Basic	23.77
Bessemer	23.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.75
Cleveland	4.75@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.50@2.70	3.89	3.45	3.80
No. 12	2.55@2.75	3.94	3.50	3.85
No. 14	2.60@2.80	3.99	3.55	3.95
No. 16	2.70@2.90	4.09	3.65	4.15
Black				
Nos. 17 to 21	3.30@3.40	4.40	4.15	4.30
Nos. 22 to 24	3.35@3.45	4.45	4.20	4.35
Nos. 25 and 26	3.40@3.50	4.50	4.25	4.40
No. 28	3.50@3.60	4.60	4.35	4.50
Galvanized				
Nos. 10 and 11	3.40@3.50	4.60	....	4.50
Nos. 12 to 14	3.50@3.60	4.70	....	4.60
No. 16	3.65@3.75	4.85	....	....
Nos. 17 to 21	3.80@3.90	5.00	....	4.90
Nos. 22 to 24	3.95@4.05	5.15	5.00	5.05
No. 26	4.10@4.20	5.30	5.15	5.20
No. 28	4.40@4.50	5.60	5.45	5.50

WROUGHT PIPE (Welded)—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	59½%	48%
3½ to 6 in. steel lap welded	48%	35%	53½%	40½%	56½%	45%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4%, less 5%; class A, plus 23%. Cast iron, standard sizes, 36% off.

Size, Inches	List Price per Foot	Diameters Inches External	Diameters Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ¼-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
¼	$0.09	50%	⅞	$0.16	35%
⅜	.11	45%	1	.18	31%
½	.14	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	6.00	4.20
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.85	8.00	7.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	7.00	8.25	7.85
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.15	4.00	3.80
Cold drawn flats, squares	4.65	4.50	4.30
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00@3.10 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb. Chicago, 5/32, 8.85c.; 3/32, 7¾c.; ⅛, 7.95c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			14.00
Tin, 5-ton lots, New York			54.25
Lead (up to carlots), St. Louis	7.55	New York	8.12½
Zinc (up to carlots), St. Louis	6.85	New York	7.87½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	12.50	16.00	14.00
Copper sheets, base	21.75	21.50	22.00
Copper wire, base	19.25	21.25	20.00
Copper bars, base	20.87½	21.50	22.50
Copper tubing, base	23.75	24.25	24.00
Brass sheets, base	18.12½	18.62½	18.37½
Brass tubing, base	22.75	25.25	26.00
Brass rods, base	15.87½	16.37½	18.37½
Brass wire, base	18.62½	20.12½	20.00

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1–15 ton lots	27.20	28.00	27.00
Zinc sheets (casks)	11.00	11.50	11.37
Solder (½ and ½), (case lots)	37.00	35.00	.....
Babbitt metal (83% tin)	60.00	63.00	50.00
Babbitt metal (35% tin)	28.00	20.50	28.00
Nickel (ingots) f.o.b. refinery	31.00	.....	.....
Nickel (electrolytic) f.o.b. refinery	38.00	.....	.....
Nickel (shot) f.o.b. refinery	32.00	.....	.....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel Metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.00@11.50	11.25	10.25
Copper, heavy, and wire	10.75@11.00	11.00	10.25
Copper, light, and bottoms	9.25@ 9.75	9.00	9.00
Heavy lead	6.25@ 6.50	6.25	6.50@6.75
Tea lead	5.25@ 5.50	3.75	5.50@5.75
Brass, heavy, yellow	6.75@ 7.25	6.50	7.00
Brass, heavy, red	8.50@ 8.75	8.75	8.00
Brass, light	5.75@ 6.00	5.50	6.00
No. 1 yellow rod turnings	7.25@ 7.50	7.00	7.75
Zinc	4.00@ 4.25	3.75	4.00

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.75	$11.45	$11.00
"A" Grade:				
IC,	14x20	9.50	9.40	8.50
	Coke Plates—Primes.			
100-lb.,	14x20	6.50	6.10	6.50
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	7.25	6.80@6.90	6.75

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.14
Cotton waste, colored, per lb.	.10@ .15½	.18	.09½
Wiping cloths, 13¼x13¼, per lb	.17	36.00 per M	.11*
Wiping cloths, 13¼x20½, per lb.	.....	45.00 per M	.11*
Sal soda, per 100 lb. keg	2.25	2.25	2.00
Roll sulphur, per 100 lb. keg	3.60	3.25	2.85
Linseed oil, per gal., 5 bbl. lots	1.07	1.24	1.26
Lard cutting oil, 25% lard, per gal.	.60	.50	.32
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.33	.35	.21
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	30–10%	30–10%	30–10%
Heavy grade	20–5%	20–5%	20–5%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50–5%	50–10%	60%
Second grade	50–10–5%	60–5%	65%

*White, at washery.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0349
Cold finished shafting	per lb.	.0415	.0415	.044
Brass rods	per lb	.1587½	.1612½	.155
Solder (½ and ½)	per lb.	.37	.38	.37
Cotton waste	per lb.	.15@.22	.15@.22	14@21
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.38	3.38	3.38
Lard cutting oil	per gal.	.60	.60	.55
Machine oil	per gal.	.33	.33	.29
Belting, leather, medium	off list	30–10%	40–2½%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	45%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$4.86	$5.84	$5.00
Emery paper	10.71	11.00	11.00
Emery cloth	28.00	31.12	32.75
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.24	1.50
Cloth	3.38	2.67	3.55
Fire clay, per 100 lb. bag		.65	.75
Coke, prompt furnace, Connellsville	per net ton		3.25@3.75
Coke, prompt foundry, Connellsville	per net ton		4.00@4.50
White lead, dry or in oil	100 lb. kegs		New York, 15.75
Red lead, dry	100 lb. kegs		New York, 15.75
Red lead, in oil	100 lb. kegs		New York, 17.25

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1½x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%. Machine bolts, up to 1x30-in., with cold punched and hot-pressed hex. nuts, also button head bolts with hex. nuts are $3.50 per 100 lb. at Cleveland.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1¼x¼-in., $1.00 per 100. List plus 35% at New York warehouses; with hex. heads, $4.65 per 100 lb. net at Chicago.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x¼-in., 2c. each. Discount 70% for $\frac{5}{16}$-in. and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x¼-in., 6c. each, less 50%.

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in., $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅜-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c., longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅜-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ala., Birmingham—Southern Steel & Rolling Mill, Inc., 3900 Tenth Ave.—rolling mill lathe, taking 16 in. roll.

Fla., Bradentown—Varney Bros.—crosscut saw, jointer, plainer, rabbeting outfit.

Ga., Brunswick—Savannah River Lumber Co., Savannah Bank & Trust Bldg., Savannah—complete equipment for saw mill, here.

Ill., Chicago—Atchison, Topeka & Santa Fe, R.R., Railway Exchange Bldg., M. J. Collins, Pur. Agt.—Baker or equal vertical high power drill, 4 in. holes, with 24 in. reach, motor drive; Landis or equal 2 in. double head bolt cutter, motor drive.

Mass., Cambridge (Boston P. O.)—J. Stewart, 976 Massachusetts Ave.—miscellaneous tools and equipment for repair and service garage, at Massachusetts Ave. and Bay St.

Mass., Charlestown (Boston P. O.)—S. Hart, 7 Franklin St.—equipment and tools for repair and service garage.

Mass., Dorchester (Boston P. O.)—C. M. Verroche, 259 Quincy St.—equipment and miscellaneous tools for repair and service garage.

Mass., Lynn — City, R. F. Handy, City Hall — small garage tools, for proposed municipal garage.

Mich., Detroit—Dept. of Street Railways, Administration Bldg., St. Jean and Shoemaker Aves. F. Meyer, Jr., Pur. Agt.—power driven arbor press.

Mich., Detroit—Dawson & Moore, 8836 Witt St.—woodworking equipment, including wood turning lathe.

Mo., St. Louis—Mobile & Ohio Railroad, W. J. Diehl, Pur. Agt., Fullerton Bldg., St. Louis—50 ton bushing press; flat turret lathe; 20 in. x 16 ft. heavy duty engine lathe; ball bearing floor grinder for wheels 36 x 36 in. x 12 ft. planer, etc., for Murphysboro, Ill., shop.

Mo., Valley Park—Barbour Boat Co.—one, 1¼ x 1¼ x ¼ capacity, angle shear.

N. Y., New York—Fischl Button Co., 512 West 41st St.—18 and 19¼ Bliss presses; 1¼ to 2 in. stroke.

O., Columbus—Federal Mfg. Co., 168 West Long St., S. Van Etten, Mgr. (manufacturers of gas fittings)—milling machines; 14-6 and 16-8 lathes; shaper; drill presses.

Ore., Portland—I. F. Powers Furniture Co., I. F. Powers, Pres., 3d and Yamhill Sts.—complete equipment for new furniture factory.

Pa., Pittsburgh—Builders Steel Works Co., 4130 Liberty Ave.—hoists and conveyors for new assembly plant.

Va., Richmond — Hackley Morrison Co., Inc., 1708 Lewis St.—48 in. vertical boring mill; 5 ton electric overhead, traveling crane, 50 ft. span, 3 ph., 60 cyc., 220 a.c.

Tenn., Memphis—G. W. Simmons, 492 Vance Ave.—48 in. endless bed sander, (used).

Tex., Jasper—J. L. Prince Lumber Co.—planers, rip saw stands, engine, etc.

Tex., San Antonio—Texas Laundry Machinery Co., 119 Blue Starr St.—machinery for manufacture of laundry equipment.

Wis., Kewaunee—Kewaunee Mfg. Co.—woodworking machinery for new furniture factory.

Wis., Marshfield—Felker Bros. Mfg. Co., Central and Depot Sts.—5-ton traveling crane, for new truck manufacturing plant.

Wis., Park Falls—Park Falls Lumber Co., c/o E. Hines Lumber Co., 2431 South Lincoln St., Chicago, Ill.—saw mill and transmission machinery for new mill here.

Wis., Racine — Andis Clipper Co., 417 Lake Ave.—nickel plating equipment and other equipment for hair clipper manufacturing plant.

Wis., Wausau—E. Helmke, 802 South 8th St.—miller, lathe, planer, grinder, electric drills, 5-ton crane, etc., for new shop on 12th Ave.

Ont., St. Thomas—J. A. Mulligan, 10, Mondamin St.—complete equipment for repair shop and garage to replace fire loss.

Que., Montreal — Canadian Graphite Corp., 435 Phillips Pl., L. Soyette, Vice-Pres.—jack hammer drill for ⅞ in. or 1 in. steel.

Australia, Melbourne—Victorian Government R.R., D. H. Ross, Secy., will receive bids until July 1st for the supply and delivery of one hydraulic spring buckle press complete with all accessories.

Opportunities for Future Business

Ala., Fairfield—Tennessee Coal & Iron Railroad Co., Brown-Marx Bldg., Birmingham, G. G. Crawford, Pres., is enlarging plant to double capacity of sheet mill. Estimated cost $1,000,000.

Calif., Santa Cruz—County of Santa Cruz, H. E. Miller, Co. Clk., awarded contract for the construction of a machine shop and garage. $13,226.

Calif., Wasco—Wasco High School Dist. will soon award contract for the construction of manual training shops.

Ga., Brunswick—Savannah River Lumber Co., Savannah Bank & Trust Bldg., Savannah, plans the construction of a saw mill, here.

Kan., Salina — Shellabarger Milling Co. plans the construction of mixing, tempering, plant and warehouse, to replace fire loss. Estimated cost $100,000.

Me., Waterville—Maine Central R.R., 222 St. John St., Portland, is receiving bids for the construction of a 100 x 100 ft. car repair shop, here. Estimated cost $40,000. B. T. Wheeler, Ch. Engr.

Md., Baltimore—T. Mullan, 4001 Greenmount Ave. will build a 200 x 252 ft. sales and service station on 20th St. and Harford Ave., by day labor. Estimated cost $200,000. Private plans.

Mass., Boston—Schoolhouse Dept., T. P. Glynn, Chrn., plans the construction of addition, including shops for wood and metal workings, to Washington School. Estimated cost, $240,000. Architect not selected.

Mass., Reading — Dennison Organ Pipe Co. awarded contract for the construction of a 2 story, 35 x 110 ft. organ pipe factory. Estimated cost $40,000. Private plans.

Mass., Rockport—Cape Ann Tool Co., Pigeon Cove, awarded contract for the construction of a 2-story plant addition.

N. H., Keene—Burdette Chair Co. plans the construction of factory to replace fire loss. Estimated cost $80,000. Architect not selected.

N. J., Trenton—Freeman Electric Co., 803 East State St., plans the construction of a 2 story plant for the manufacture of electrical equipment and supplies. Estimated cost $40,000.

O., Cleveland—Economy Fixture Co., T. McWeeny, Vice-Pres., 5408 Bragg Road, is receiving bids for the construction of a 32 x 67 ft. furnace room at Bragg Road. Estimated cost $40,000. Private plans.

O., Cleveland—E. McGeorge, 3030 Euclid Ave., Archt. and Engr., is receiving bids for the construction of a 160 x 160 ft. factory, 42 x 160 ft. garage, boiler house storage building, etc., on East 131st St., for the Elyria Iron and Steel Co., 232 East 131st St. Estimated cost, $200,000. H. B. Wilds, Pres.

O., New Philadelphia — Canton Bridge Co., Belden and 10th St. N. E., plans the construction of a steel fabricating mill here. G. C. Hines, Pres.

Ore., Portland — I. F. Powers Furniture Co., I. F. Powers, Pres., 3rd and Yamhill Sts., will receive bids about May 20th for the construction of a 5 story, 100 x 200 ft. furniture factory and warehouse on East 3rd, Comb and Davis Sts. Estimated cost $250,000. Clausen & Clausen, McCleay Bldg., Archts. J. H. Keller, Worcester Bldg., Engr.

Pa., McDonald—McDonald File & Steel Co. awarded contract for the construction of a 45 x 360 ft. factory. Estimated cost $100,000.

Pa., Philadelphia—Lincoln Way Auto Repair Shop, 6201 Girard St., is receiving bids for the construction of a 2-story, 50 x 50 ft. shop at 512 North 62nd St. Estimated cost $15,000. Private plans.

Pa., Philadelphia—O'Brien Cooperage Co., Wharton and Water Sts., awarded contract for the construction of a 2-story, 60 x 107 ft. cooperage, at plant. Estimated cost $40,000. Noted Apr. 30.

Pa., Philadelphia—H. C. Peddey, Corn Exchange Bldg., awarded contract for the construction of a 200 x 220 ft. manufacturing plant at Torresdale Ave. and North St. Mack International Motor Truck Co., lessee.

Pa., Philadelphia—B. Ridgeway & Son, 9th and Columbia Sts., will build a 22 x 140 and 18 x 120 ft. shop, on Clarissa and Bristol Sts., by separate contracts. Private plans.

Pa., Pittsburgh—Builders Steel Works Co., 4130 Liberty Ave., plans the construction of an assembly plant on Howley St. Estimated cost $500,000. Private plans.

Pa., Reading—Philadelphia and Reading R.R. Co., Reading Terminal Bldg., Philadelphia, will receive bids until May 13, for the construction of a 335 x 880 ft. freight car repair shop, here. S. T. Wagner, Ch. Engr.

Tex., Dallas — Atlanta Plow Co., C. L. King, Pres., 1200 Marietta St., Atlanta, Ga., plans the construction of a plow factory, here. Estimated cost $1,000,000. Engineer and architect not selected.

Tex., Jasper—J. L. Prince Lumber Co. plans the construction of a saw mill, 25,000 bd. ft. per day capacity, at Morris' Ferry, near here. Estimated cost, $35,000. Private plans.

Tex., San Antonio—Texas Laundry Machinery Co., 119 Starr St., plans the construction of a plant for the manufacture of laundry machinery. Estimated cost $35,000. Private plans.

Wash., Longview—Weyerhauser Timber Co., Everett, plans the construction of a lumber mill, to include sash and door factory, planing mill, and by products plant, on the Columbia River, near here. Estimated cost $1,000,000. G. S. Long, Gen. Mgr.

Wis., Kewaunee—Kewaunee Mfg. Co. will build a 3-story, 52 x 140 ft. furniture factory, by day labor. Private plans.

Wis., Marshfield—G. A. Krasin, Central Ave., Archt., is taking bids for the construction of a 66 x 77 ft. plant for the manufacture of steel trucks and bodies, for Felker Bros. Mfg. Co., Chestnut and North Depot Sts. Estimated cost $25,000. Noted Apr. 30.

Wis., Park Falls—Park Falls Lumber Co., c/o E. Hines Lumber Co., 2431 South Lincoln St., Chicago, Ill., plans the construction of a saw mill here, to replace fire loss. Estimated cost $200,000. Architect not selected.

Wis., Racine — Andis Clipper Co., 417 Lake Ave., awarded contract for the construction of a 2 story, 116 x 120 ft. factory for the manufacture of electric hair cutting clippers. Estimated cost $45,000. Private plans.

Wis., Wausau—E. Helmke, 802 South 8th St., will build a machine shop and foundry on 12th Ave. by day labor. Estimated cost $40,000. Private plans.

Ont., St. Thomas—J. A. Mulligan, 10 Mondamin St., plans the construction of a garage and auto repair shop, to replace fire loss. Estimated cost $65,000.